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A Technological History of Municipally Owned Public Transportation in Edmonton, 1893-1981

by

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George H. Buck

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE
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in partial fulfillment of the requirements for the degree of Master of Education

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Date April 3, 1985

Dedication

I wish to dedicate this thesis to the memory of Dr. Henry R. Ziel who was the first Chairman of the Department of Industrial and Vocational Education at the University of Alberta, and who encouraged me in my effort to explore a new area of educational research: technological history.

> Youngsters should be permitted an exploratory environment that is not confined to woods, metals, drafting or similar craft oriented interpretations of our productive society . . . they must recognize the impact of the various technologies, materials, processes and man technology confrontations. (Ziel, 1971, pp. 5-6)

Abstract

This thesis chronicles the origins and the technological development of municipally-owned public transportation in Edmonton from 1893 through the early 1980's. The transportation modes such as street railways, buses and Light Rail Transit are divided into categories and are described and analyzed in a chronological fashion. The necessary plant as well as the various types of rolling stock and their required ancillary systems are also divided into categories and are described and analyzed in considerable detail. Figures, plates and maps are employed to supplement descriptions and observations concerning construction, rolling stock and installations.

Modifications to equipment and the plant are noted and described, with particular emphasis placed upon descriptions and explanations of modifications to plant and rolling stock brought about by local factors peculiar to Edmonton. In addition to a complete textual description of rolling stock, an extensive listing of all the major features of each unit of rolling stock is provided to facilitate clarity and comparisons.

Apparent trends in technological development are included as well as suggested applications for the content to educators, transit personnel, historians and individuals or groups engaged in restoration or preservation work.

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AC	Allis Chalmers
A.C.	Alternating Current
ACF	American Car and Foundry
AEC	Associated Equipment Company
ALCO	American Locomotive Company
ASCE	American Society of Civil Engineers
BRC	Board of Railway Commissioners
B.C.	British Columbia
BBC	Brown Boveri Company
B Boveri	Brown Boveri Company
CCF	Canadian Car and Foundry
CEAR	City of Edmonton Annual Report
CECR	City of Edmonton Commissioners' Report
CEED	City of Edmonton Engineers' Department
CGE	Canadian General Electric
CEUCR	City of Edmonton Utilities Commissioners' Report
CNR	Canadian National Railways
CNoR	Canadian Northern Railway
CPR	Canadian Pacific Railway
D.C.	Direct Current
DE	Double End
Duewag	Waggonfabrik Uerdingen
EE	English Electric
EIR	Edmonton Interurban Railway
EL&PD	Electric Light and Power Department

EL&PDAR	Electric Light and Power Department Annual Report
EPAR	Edmonton Power Annual Report
ERR	Edmonton Radial Railway
ET	Edmonton Transit
ETAR	Edmonton Transit Annual Report
ETS	Edmonton Transit or Transportation System
ETSAR	Edmonton Transit System Annual Report
ETSMR	Edmonton Transit System Monthly Report
EY&PR	Edmonton Yukon and Pacific Railway
FE-CE	Front Entrance - Centre Exit
FIL	Flyer Industries Limited
FTC	Fageol Twin Coach
GE	General Electric (United States)
GEC	General Electric Company (Britain)
GMC	General Motors Coach
GTP	Grand Trunk Pacific
h	Hour
H.P.	Horse Power
kg	Kilogram
km	Kilometre
K&M	Kummler and Matter
kN	Kilonewton
kPa	Kilopascal
kW	Kilowatt
Lbs.	Pounds
LRT	Light Rail Transit
m	Metre

McG-C	McGuire-Cummings
MCB	Master Car Builders
mm	Millimetre
MRC	Magnetic Remote Control
MU	Multiple Unit Operation
N/A	Not Applicable
NAR	Northern Alberta Railways
N.B.	New Brunswick
OCC	Ottawa Car Company
OCM	Ottawa Car Manufacturing Company
PAYE	Pay As You Enter
PC&C	Preston Car and Coach Company
PDAR	Power Department Annual Report
SE	Single End
SI	Système International d'Unités
SRD	Street Railway Department
SRDAR	Street Railway Department Annual Report
SRDGL	Street Railway Department General Ledger
SRDMR	Street Railway Department Monthly Report
SRDNMR	Street Railway Department Nine Months Report
SRDPTR	Street Railway Department Permanent Track Report
TDH	Transit Diesel Hydraulic
TTC	Toronto Transit or Transportation Commission
T&YRR	Toronto and York Radial Railway
U.L.	Underwriters' Laboratory
WFC	Western Flyer Company
WH	Westinghouse

Chapter I

The Problem

Introduction

The construcltion of a municipally-owned public transportation system in Edmonton began in the year 1907. Since its inception as the Edmonton Radial Railway in 1908, the Edmonton Transit System (now known as Edmonton Transit) has undergone many changes in plant, equipment and maintenance procedures. Most of these changes were brought about through circumstances such as: improvements in the general technology available; need for greater safety; economic conditions; failure of materials or systems in operation. Some of the changes implemented did improve the efficiency and the operation of the system; while other changes either hindered it or had no effect. A work that describes and analyzes these changes could be beneficial to those people who have an interest in teaching the development of various technologies that are found, or that have been found, in twentieth-century North American society.

Some authors, such as Campbell (1978) and Hatcher and Schwarzkopf (1983), have written works which describe the development of the Edmonton Radial Railway/Edmonton Transit. These works, however, are primarily concerned with the social aspects and personal anecdotes associated with the Edmonton Radial Railway/Edmonton Transit. Although a limited number of technical aspects of the system are mentioned by these writers, they are often incomplete and inaccurate. These authors, as well as others who have written about the system, have obtained their data mainly from secondary sources, personal recollections, employees and former employees. While the occasional reference is made by these authors to a primary source, no evidence exists that shows that these writers have based their works on information gathered from primary sources.

The need for rigorous, scholarly and objective research which deals specifically with the history of the Edmonton Radial Railway/Edmonton Transit, from the viewpoint of technological change and development, can be seen for the following reasons: no work yet exists which accurately and fully describes the technical aspects of all the rolling stock and related plant from 1907 to 1980; no work exists which attempts to explain the reasons why changes to rolling stock, plant and maintenance procedures came about; no work yet exists which enables the reader to trace the technological changes and developments in the Edmonton Radial Railway/Edmonton Transit from 1907 to 1980.

Statement of the Problem

The purpose of this technological history was to describe: the factors which determined the technologies used by the Edmonton Radial Railway/Edmonton Transit; how these technologies changed and developed between 1907 and 1980; and the reasons why these changes and developments occurred.

Major Objective

The major objective of this technological history was to provide an accurate, complete and chronological account of the development and changes to the physical plant and equipment used by the Edmonton Radial Railway/Edmonton Transit from 1907 to the end of 1980.

Objective

The major objective was realized with aid from the following supporting objectives.

- To describe the methods and materials used in the construction and maintenance of the: roadbed, track, electrical generation and electrical distribution systems of the Edmonton Radial Railway/Edmonton Transit in the time frame established for the research (1907 - 1980).

- To describe the construction, operating principles and modifications to each type of rolling stock (passenger and freight) from the time that it was either purchased or built, to the time that it was disposed of, or to the end of 1980.

- To compile a roster of all rolling stock used between the years 1908 and 1980. The roster will include: name of manufacturer(s), vehicle model or designation, serial numbers (if any), year(s) of manufacture, year of delivery, condition of delivery, distinguishing characteristics, major dimensions, type of body construction, type of frame or chassis construction, types of brakes, types of trucks (for rail vehicles only), number and type of motor or engine, gear ratios or type of transmission, type of electrical control (electric vehicles only), year withdrawn from service, year disposed of, final disposition (if known).

- To describe the reasons why each particular design or type of vehicle was selected and to describe why some designs were superseded by others.

- To describe the various operational and environmental factors peculiar to Edmonton which contributed to the type of rolling stock and plant selected and which contributed to the modifications and changes to the rolling stock and related plant.

Significance of the Study

Industrial Arts is a subject area that is not characterized by teaching and research in only one particular area of technology. The study of the technology of transportation is, therefore, of considerable importance. The movement of goods and people has been, and is, extremely important to the successful functioning of any industrial society. H. R. Ziel (1971) said of power systems and their related technologies, "They are increasingly becoming more dominant in our daily productive lives and in our leisure activities. Therefore, power and its systems as a unique technology become a viable area of study for industrial arts" (p. 76). The importance of the historical aspects of power and transportation technology have been emphasized recently. In The Technology Teacher, a periodical of the American Industrial Arts Association (February 1984), the article entitled "Resources in Technology" contains a section which describes, briefly, the history of transportation. (pp. 23-26) Where twentieth-century land transportation is described, however, only American developments and applications are mentioned. No consideration is given to environmental factors nor to developments in transportation technologies that are unique to Canada. This technological history provides information that was previously lacking on aspects of Canadian transportation technology in one of Canada's major cities.

Both the junior high school and the senior high school curriculum guides for industrial education (industrial arts) include either a field of study called "Power Technology", or the career field of "Power". Power Technology is taught at the junior high school level and as a field of study is comprised of four modules. One of these modules is Power Mechanics. Power is one of the four career fields taught at the senior high school level and consists of thirteen modules. An in-depth critical analysis of these curriculum guides shows that the development of the learning activities are factors that influence technological change in all transportation systems.

This technological history will enable individual industrial arts teachers, as well as curriculum planners, to design units of instruction and study concerned with: power transmission, development of power systems, factors that have influenced technological change, the operation of large electrically powered vehicles, the operation of propane, diesel and gasoline powered vehicles.

Since, at the time of writing, no other study of a similar nature exists at this institution, this technological history may be used by other scholars and by other institutions as a research model. The study may also be useful to those individuals who plan and who implement changes to the plant and equipment of Edmonton Transit. Above all, this technological history may have uses and applications that will become apparent in the future.

Limitations of the Research

The study had the following limitations imposed upon it.

It was limited to describing the technical history of the public transportation system of Edmonton, from its beginnings in 1906, through the end of 1980. References to other transportation systems were made only to provide background and clarity.

It was limited to descriptions and analyses of technical installations and technical developments. References to: routes, routing, scheduling, fares, fare collection, personnel, and other individuals, was made only to provide clarity.

The completeness of the study was limited by the amount of primary source material, including photographs, manufacturers' records and data, and archival records that were available to the researcher.

The precision of the study was limited by the accuracy of the primary sources and the archival records and photographs used.

Major Assumption

The major assumption of this study was that the information contained in available primary sources was accurate. Van Dalen (1962) stated that, "Printed and written materials are not necessarily accurate. Sometimes clerks make errors in recording information; . . .official records are altered or slanted to give a better picture of conditions than actually exists" (p. 194). It was assumed, however, that the available primary sources were accurate unless evidence to the contrary was discovered or provided.

Methodology

In this study, data and information were gathered mainly from the following primary sources: manufacturers' records and specifications, equipment and construction contracts, City Commissioners' Reports, Street Railway Department Monthly Reports, Street Railway Department Annual Reports, correspondence between manufacturers and Street Railway officials or City Commissioners, Street Railway Departmental records, photographs, actual equipment and installations, shop foremen's log books, and historical technical books.

Where specific information considered necessary to this study did not exist in these primary sources, an attempt was made to locate the information in secondary sources such as transportation journals and newspapers. At no time in this study were contemporary accounts or anecdotal accounts used.

CHAPTER II

Background and Origins

Introduction

Edmonton, which is located adjacent to the North Saskatchewan River at approximately 53°29' North latitude and 113°49' longitude West of Greenwich (Lowe's Directory of the Edmonton District, 1899, p. 3) has been, since it was a Hudson's Bay Company fort in the early nineteenth century, an important location for transportation, trade and settlement. Technological improvements and conveniences were introduced as Edmonton grew in the late nineteenth century. A private electric light system and plant began operating in this centre in 1891. (Government of Canada, Department of the Interior, Water Resources Paper No. 33, 1922, p. 33) This operation began before Edmonton was an incorporated town. The population of Edmonton in 1890 was approximately 300 people. (City of Edmonton Statistical Records) Edmonton became a town in 1892. (Ordinances of the North-West Territories, 1891-1892, No. 7, p. 13)

Initial Legislation

The origins of the street railway in Edmonton began in 1893 when the Territorial Government empowered, "The Municipality of the Town of Edmonton to construct and operate a tramway" (Ordinances of the North-West Territories, 1893, No. 32, p. 277). This Ordinance authorized the Town, not a company, "to construct, maintain, equip and operate . . . a single or double track [i.e., one or two sets of tracks] tramway . . . along any of the streets of the Town and upon any lands therein acquired for the purpose" (Ordinances of the North-West Territories, 1893, No. 32, p. 278). The Ordinance continued by stating that the lines of the tramway could travel beyond the Town limits, as those limits existed in 1893, up to a distance of 5 miles (8.05 km). The Ordinance also allowed the tramway to connect with the Calgary and Edmonton Railway near its northern terminus. In 1893 the terminus of the railway was located on the south side of the North Saskatchewan River in what was then called South Edmonton. South Edmonton later became the Town of Strathcona in 1899. (Ordinances of the North-West Territories, 1899, Chapter 28) Edmonton was not allowed, however, to construct a bridge across the North Saskatchewan River. The tramway was to be transported by river ferry in the warm months and could traverse the river during winter months by means of a track laid across the ice. (Ordinances of the North-West Territories, 1893, No. 32, p. 279) No bridge across the river at Edmonton had yet been built.

The tramway was permitted to transport both freight and passengers. The motive power of the tramway could be provided by animals, electricity, or any other form of power except steam. Electricity appears to have been the preferred means of power as the Ordinance describes the various pieces of equipment that the town could erect and construct for the production and distribution of electricity for the tramway. (Ordinances of the North-West Territories, 1893, No. 32, p. 279) Burch (1911) indicates that by 1893, electric street railways had proven to be more efficient and cheaper to operate than street railways using horses or mules. In addition, several Canadian cities such as Victoria, Toronto and Winnipeg were successfully operating electric street railways by 1893. (pp. 2-11)

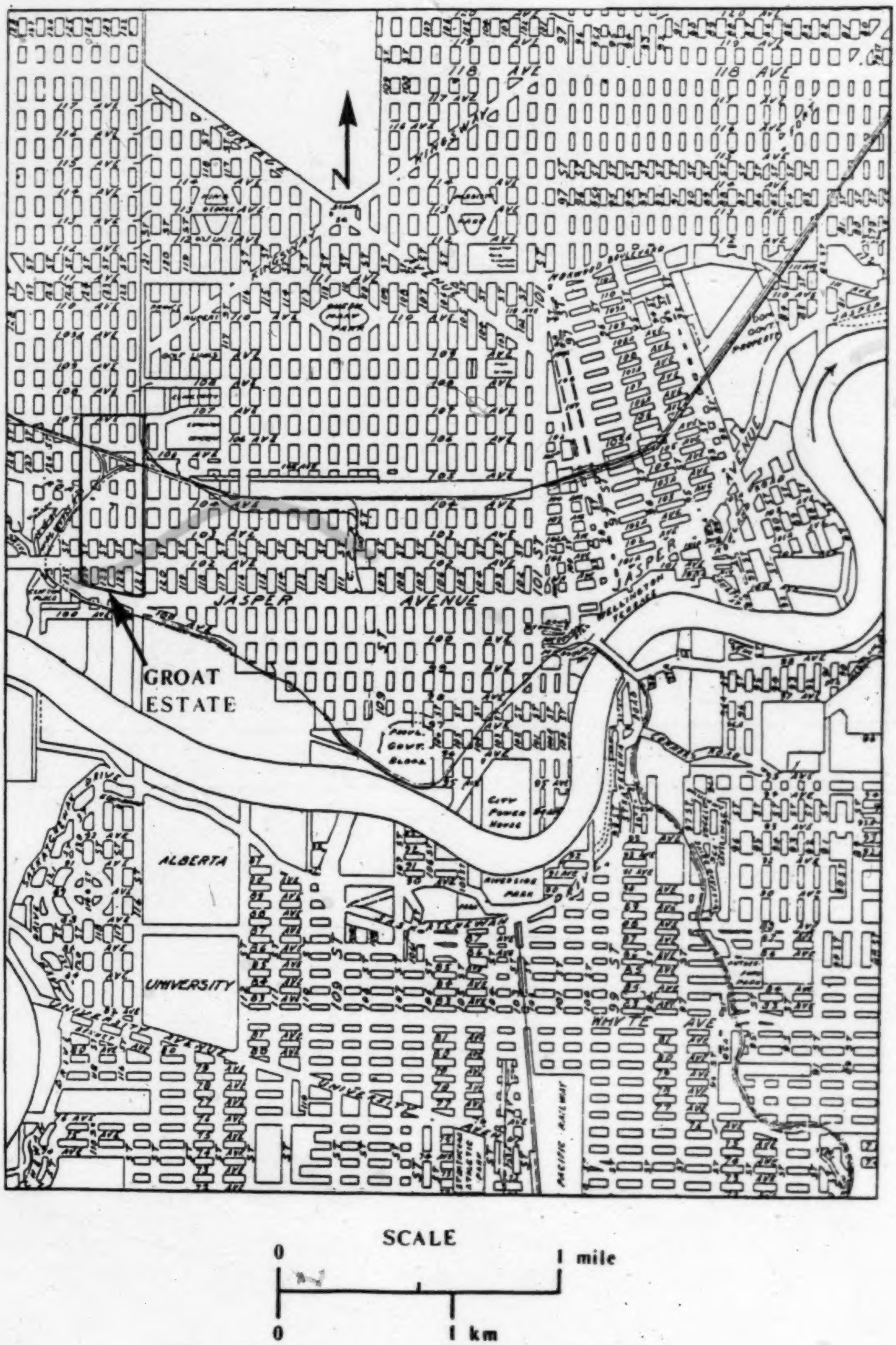
Funding for the tramway could be borrowed or could be obtained by issuing debentures, bonds and other securities subject to by-laws. (Ordinances of the North-West Territories, 1893, No. 32, pp. 280-281) The Town of Edmonton was also authorized, when supported by its ratepayers, to enter into agreements with private companies who would construct or operate the tramway, provided that the agreement would last no longer than twenty years. In any event, the town would ultimately control the tramway. The guidelines listed in the 1893 Ordinance were unusual insofar as it appears that most other Canadian and American street railways were constructed, owned and operated by private companies.

Construction by Private Company

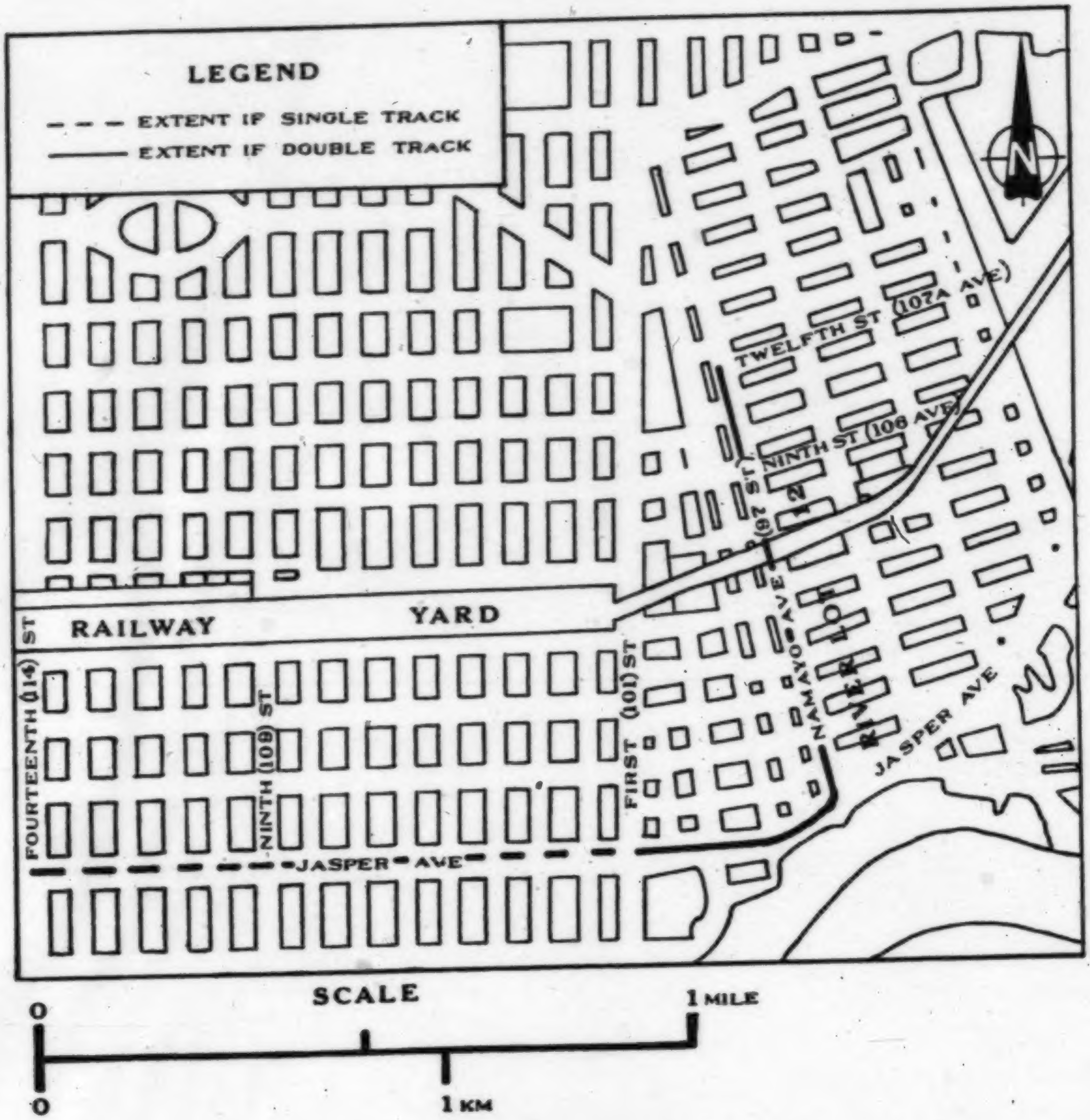
No definite action was taken in Edmonton to construct a tramway before 1904. In February of that year, a proposal for the construction and operation of a private electric street railway was submitted to the Town Council. (Edmonton Evening Journal, 1904, February 20, pp. 3-4) The proposal was made by the Edmonton Street Railway Company, its provisional directors, and Mr. William G. Tretheway who was a real estate agent then working in Edmonton. The proposal was found to be in need of revision and a revised version of it was submitted to the Town Council in March 1904. On March 10, the ratepayers of Edmonton voted on this proposal. The vote was in favor of the Town accepting the terms as described. (Edmonton Evening Journal, 1904, March 23, p. 4) There was not, however, total acceptance of the proposal among members of the Town Council. Mayor William Short vacated his chair before the Council voted and later refused to sign the Agreement after the Council had given its approval. Councilor May, acting on behalf of the Mayor, signed the Agreement. A press report (Edmonton Evening

Journal, 1904, March 23, p. 4), stated that Mayor Short felt that the Agreement did not comply with the terms of the 1893 Ordinance. The Mayor further felt that by allowing the Edmonton Street Railway Company to generate its own electricity, the Town would be deprived of revenue it otherwise would have received if it were to supply the power for the street railway.

The terms of the Agreement stipulated that the Edmonton Street Railway Company was to commence construction by June 1904 of at least 2 miles (3.2 km) of track within the Town limits. The track was to be laid along Namayo Avenue (97th Street) from Jasper Avenue north to 12th Street in River Lot 12 (later McCauley Street, now 107A Avenue), and west along Jasper Avenue to complete the required 2 miles (3.2 km). (Memorandum of Agreement [revised], 1904, p. 4) The route just described differs slightly from the route described in the initial proposal. In the unrevised version of the proposal, the line on Namayo Avenue (97th Street) was to be built only as far as 9th Street (later Sutherland Street, now 106th Avenue). (Edmonton Evening Journal, 1904, February 20, p. 3) Neither the initial proposal nor the Agreement state whether the line to be constructed was to be single-track or double-track. Map 2 (after Official Map of the City of Edmonton, 1938 and Mundy's Street Index Map of Edmonton, 1915) illustrates the route described in the Memorandum of Agreement. Two western termini are indicated, one for the extent of a single-track line, the other for the extent of a double-track line. A penalty clause required that the sum of $10,000.00 be entrusted to the Town by the Edmonton Street Railway Company. If streetcars were not actually operating on the specified 2 miles (3.2 km) of track by September 1, 1905, the Street Railway Company would forfeit both the deposit and all rights and privileges covered in the


N
118 AVE
JASPER AVENUE
GROAT
ESTATE
ALBERTA
UNIVERSITY
WHYTE AVE
RIVERSIDE PARK
CITY POWER HOUSE
PACIFIC RAILWAY
SCALE
0
1 mile
0
1 km

MAP 1. LOCATION OF GROAT ESTATE


LEGEND
– – – EXTENT IF SINGLE TRACK
—— EXTENT IF DOUBLE TRACK
N
TWELFTH ST (107A AVE)
NINTH ST (106 AVE)
(97 ST)
RAILWAY YARD
FOURTEENTH (114) ST
NINTH (109) ST
FIRST (101) ST
NAMAYO AVE
RIVER LOT 12
JASPER AVE
JASPER AVE
SCALE
0
1 MILE
0
1 KM

MAP 2. MARCH 1904 PROPOSED ROUTE
EDMONTON STREET RAILWAY COMPANY

Agreement. (Memorandum of Agreement [revised], 1904, p. 11) This penalty clause was the largest change made between the unrevised and the revised versions of the proposal, but there were other changes as well. In the initial proposal, a deposit of $25,000.00 was to be made to the Town by the Street Railway Company. For each year that the 2 mile (3.2 km) line remained incomplete the Company would forfeit only $5,000.00, less the accrued interest. This situation could continue for as long as five years, at which time the remainder of the deposit would be forfeit and the Agreement would become null and void. (Edmonton Evening Journal, 1904, February 20, p. 4)

Motive power and technical matters were covered extensively in the Agreement. The Company was to use the standard railway gauge of 4 feet 8½ inches (1 435 mm) with T-section rails of a weight of at least 40 pounds per yard (29.76 kg/m). The streetcars were to be electrically powered and were to have enclosed vestibules and warning bells or gongs. Power distribution was to be by means of a wire strung parallel with the rails at a designated height above the mid-point between the rails. The return current was to travel through "proper conductors", such as the rails and was not to travel through water mains. (Memorandum of Agreement [revised], 1904, pp. 5-7) If current travelled from a cast iron water pipe to a buried copper cable, for example, the action known as electrolysis would take place. Doane and Parkham (1926) state that, "whenever electricity flows from a metal conductor into damp earth, the conductor is eaten away, provided that the drop in voltage between the conductor and the adjacent earth is sufficient to effect the chemical decomposition" (§ 20 p. 41). Electrolysis was a major problem with other electric street railways and it was, as will be seen later, a chronic problem of the municipally-owned Edmonton Radial Railway.

The Memorandum of Agreement of 1904 reflected some of the technological improvements in the street railway industry since the Ordinance of 1893. Horse-powered vehicles were no longer considered and definite standards for construction and safety were introduced.

The change of the penalty clauses between the initial proposal and the Agreement, coupled with Mayor Short's apprehension, were indications that some felt that the Edmonton Street Railway would never operate a streetcar. A press report of June 1, 1904 seemed to refute this view. It stated that the Edmonton Street Railway Company was saving its deposit, as a contractor was hauling and piling gravel along Namayo Avenue (97th Street). (Edmonton Evening Journal, p. 5) In the same edition of the newspaper a large advertisement appeared that was worthy of note. It read, "BUY NOW. The Deposit of $10,000 has been made with the City [incorrect, as Edmonton was a town until October 1904. (Ordinances of the North-West Territories, 1904, Chapter 19)] and Street Railway Construction begins June 1. The Groat Estate is rapidly becoming an important part of Edmonton" (p. 4). The agent for this land development was a T. A. Stephen who, coincidentally, was also a director of the Edmonton Street Railway Company (see map 1 for the location of Groat Estate). (Edmonton Evening Journal, 1904, March 25, p. 1) It would appear that a street railway, or a promise of one, encouraged people to move to areas that were not close to the Town centre. It is also possible that Tretheway and the directors of the Edmonton Street Railway Company never had any intention of completing their street railway. It may be said that their main reason for agreeing to build one was to sell their lots in Groat Estate by any means possible.

By the end of August 1905, it was apparent that the Edmonton Street Railway Company would cease to exist. No construction had taken place, the piles of gravel were still sitting on Namayo Avenue, and no equipment had been purchased. (Edmonton Daily Bulletin, 1905, August 22, p. 1) On September 1, the deposit became the property of City (a city since October 1904), the Agreement between the Edmonton Street Railway Company and the Town of Edmonton became null and void, and City crews began spreading the abandoned gravel along Namayo Avenue. (Edmonton Daily Bulletin, 1905, September 5, p. 8) The first attempt at constructing a street railway in Edmonton was a dismal failure. Since a private company was responsible for the failure, an attitude of skepticism towards similar proposals from private companies prevailed in Edmonton for some time. Events that had been occurring in Strathcona, Edmonton's rival on the south side of the North Saskatchewan River, would further encourage the City of Edmonton to build its own street railway.

Strathcona Radial Tramway Company

During 1904, the Government of the North-West Territories incorporated a private company known as the Strathcona Radial Tramway Company Limited. (Ordinances of the North-West Territories, 1904, Chapter 34, p. 255) The Ordinance specified that individuals, not the Town of Strathcona, were responsible for the construction and operation of the street railway. There were, however, several provisos. If the Company wished to construct and operate lines in Strathcona, or in any other municipality, the Company would have to obtain permission from the municipality concerned. The Company had three years to construct at least 15 miles (24.14 km) of track before the powers granted by the Ordinance ceased. (Ordinances of the North-West Territories, 1904, Chapter 34, p. 256)

Municipal Street Railway in Edmonton

In 1906 the Strathcona Radial Tramway Company submitted a proposal to the City of Edmonton asking for a franchise to enable the Company to construct and operate a street railway system in Edmonton in conjunction with an interurban line to Strathcona. (The Railway and Marine World, 1906, November, p. 675) The Edmonton City Council decided that a proposal from the City Engineer regarding a municipally-built system should also be considered. On October 25, 1906, Edmonton City Council decided against granting a franchise to the Strathcona Radial Tramway Company. (The Railway and Marine World, 1906, December, p. 753) By November 1906, Edmonton City Council had instructed the City Engineer to prepare an estimate for the cost and construction of a street railway system. (The Railway and Marine World, 1906, November, p. 675) The Engineer's proposal called for the construction of a total of 7.5 miles (12 km) of track. Three miles (4.8 km) were to be single-track construction and the remainder was to be double-track construction. The estimate included detailed specifications such as those for track construction. The total cost of construction was estimated to be $100,700.00. (The Railway and Marine World, 1906, December, p. 753) From this estimate, the City Council decided that a municipally-owned street railway was feasible.

Early in 1907, the City of Edmonton Commissioners placed an order for 470 tons (477 520 kg) of 80 pound per yard (33.2 kg/m) T-section rails, for delivery in March. (The Railway and Marine World, 1907, February, p. 111) A municipally-built street railway in Edmonton was started.

Review of Related Literature

Apart from primary source materials and press reports of the time, there are only a few modern works that deal either with the technical aspects or with the history of the Edmonton Radial Railway/Edmonton Transit (ERR/ET). Most of the works that were available presented brief, and often unsupported, anecdotal accounts of specific humorous or seemingly important events in the ERR's/ET's history. Such works were of no consequence or concern to this study. A small number of works, however, did attempt to provide accurate accounts of the history of the ERR/ET. It is with these works that this section is concerned.

The first, written and published by the staff of the Edmonton Transit System (ETS, now ET) during 1966, is entitled Edmonton Transit System Condensed History of Events, 1908 to 1966. This work, which is only 19 pages in length, contains several photographs and maps and lists significant events and their dates. Equipment listings are also provided but the pamphlet does not deal with the technical aspects of construction or operation of the ERR. No sources for the material are cited. While some of the information in the pamphlet can be substantiated by consulting various primary sources, much of the information is inaccurate and unsupported. In some instances, subsequent works have used the pamphlet as source material. Several errors that appear in the pamphlet have, therefore, been perpetuated. One example of this can be found on pages 1 and 14. It is stated that the external color scheme applied to the streetcars purchased in 1908 consisted of two tones of brown. The error is that the color scheme did not use any shade of brown at all. A press report of October 29, 1908 stated that the streetcars were painted green, with natural wood trim and gold letters. (Edmonton Bulletin, p. 8) In addition to the press report, contracts for subsequent orders of streetcars describe the paint scheme as a combination of green and red; the green being applied below the windows, the red being applied above the windows to the roof, which was painted black. (Ottawa Car Company Contracts for streetcars, November 1909, October 1910, December 1910) In addition to presenting some erroneous and unsupported information, the pamphlet excludes many important technical matters. At no point, for example, does the pamphlet explain that many of the streetcars were originally constructed as double-end (could be operated from either end) vehicles and that most were later reconstructed to single-end operation.

While the pamphlet provides the reader with a cursory history of the ERR/ETS, it cannot be considered a serious work.

The next relevant work to appear was a privately-published book by E. E. B. Campbell (1978) Edmonton Transit System Story, 1903-1978. This work was the first extensive account of the history of the ERR/ET. Most of the information contained in the book was obtained from two sources, the 1966 ETS pamphlet and press reports from the Edmonton Journal and Edmonton Bulletin newspapers. The author, however, claimed that her information was, "gleaned from every possible available source and verified" (p. ii). Her claim does not appear to be true because many, if not most, parts of her account are unsubstantiated. One example may be found in her description of the events leading to the formation of the ERR. She describes the history of an earlier venture, the Edmonton Street Railway Company. Although the company failed to construct a street railway, she claimed that, "by September 1905, tracks were actually laid --- [sic.] at least two miles" (p. 9) No source for this statement is cited and an investigation of the press reports of the time reveal that the only construction that took place was the deposition of several mounds of gravel along Namayo Avenue (97th Street). (Edmonton Journal, September 5, 1905, p. 8) Campbell also perpetuated the error in the pamphlet about the original streetcar color scheme. Like the ETS pamphlet, Campbell's book tends to avoid descriptions and explanations of technical matters. While there are many discrepancies and errors in the work, it would serve no purpose to cite further examples.

Campbell's book is, clearly, a labor of love which contains some valuable information. The work, however, cannot be considered a suitable source for research because the frequent errors and erratic documentation make it unreliable.

The June 1980 issue of Canadian Rail contained an article on the history of Edmonton's streetcars. The article, Edmonton Streetcars, 1908 to 1979, was written by L. Marsh. Marsh's article, like the ETS pamphlet, is short and did not cite any sources. Although Marsh's article contains more information about technical matters than previous works, much of the information presented is inaccurate or incomplete. An example may be found on page 164 where the author states, "There was no heat in the early streetcars, nor were there any storm windows . . .". The contracts for the first seven streetcars indicate clearly that 14 electric cross-seat heaters (10 in the case of streetcar 7 which was smaller than numbers 1 to 6) were to be installed in each streetcar. (Ottawa Car Company Contracts for streetcars, September 1908) In addition, the same document also states that all side windows were to be fitted with storm sashes. Further proof of the existence of the storm sashes may be found on a photograph that was included in the article. (p. 166) The Provincial Archives of Alberta photograph depicts streetcar number 2 on an Edmonton street on October 29, 1908. A visual comparison of the side and end windows reveal that the side windows did possess storm sashes. Marsh also perpetuated the color scheme error that had been started by the 1966 ETS pamphlet. (p. 166)

Although the article in Canadian Rail contains unsupported material, it served a purpose by informing a large number of readers of the existence and the basic development of the ERR.

In 1983, Railfare Enterprises published a book that dealt exclusively with the history of electrically-powered public transportation vehicles in Edmonton. Edmonton's Electric Transit, by C. K. Hatcher and T. Schwarzkopf, attempts to provide the layman with an anecdotal and social account of the development of electrically-powered public transportation in Edmonton. The book is profusely illustrated and contains several maps. The work, unlike the works discussed previously, contains footnotes for much of the material. This book was designed primarily for the general public and was not intended to be a scholarly report.

While the book appears, initially, to be thoroughly researched and written, there are many instances where the authors have made unsupported statements, and where they have perpetuated errors found in previous works. One such example may be found on page 14 where Hatcher describes the external color scheme of the first streetcars. "The color scheme on these original cars when they were delivered is uncertain, but it is thought to have been two tones of brown". Hatcher does not cite any source for this information. It should be noted that the earliest reference to a two-tone brown paint scheme was the ETS pamphlet of 1966. Another example of an unsupported statement may be found on page 28 where it is stated, "About the same time, a spur was actually constructed in Edmonton from the ERR line on Jasper Avenue at Ninth (109) Street to the Hardisty Brothers Warehouse, so that freight could be delivered or picked up by the street railway". A press report is cited. An analysis of that report shows that it made no reference to any spur in Edmonton. In addition, no record of the spur could be found in primary sources that were researched, including two ERR maps, one from 1908 and the other from 1911. These maps showed the extent of ERR trackage in those years.

Both authors mention and describe technical matters in a haphazard fashion. Hatcher, for instance, attempted to describe the methods and materials used in the permanent track construction of 1907 and 1908. His description, although extensive, failed to include the type, size and weight of the rails used. In addition, no mention was made of the type of special work installed nor the procedures required for proper installation. (see thesis Chapter III for further elaboration) The next type of construction that was described by Hatcher was the method that the ERR introduced in 1913 for the construction of permanent track. The methods and materials used between 1909 and 1912 were ignored, as well as most of the construction methods that were used after 1913.

In the sections that describe the trolley buses used in Edmonton, Schwarzkopf introduces several specialized terms such as "resistance heaters" and "Ohio Brass harps and shoes" (p. 149). He does not, however, explain what these items are or what the terms mean. It is left to the knowledge and the imagination of the reader to figure out what is meant by the terms. In addition, Schwarzkopf provides elaborate descriptions of the first 6 trolley buses purchased, including the names of the manufacturers of the traction motors and their horsepower (kW) rating. According to Schwarzkopf, the power of the traction motors was a significant factor in determining whether a particular type of trolley bus was suitable for use in Edmonton. (pp. 148-150 & p. 157) No further mention of trolley bus motors is made until Appendix III, where the reader may discover that certain trolley buses built between 1947 and 1954 had motors that were rated at 140 H.P. (104.4 kW). (p. 195) The reader is not, however, informed of the name of the manufacturer nor the ratings or manufacturers of the motors installed on trolley buses built between 1942 and 1946. Although there are many more inaccuracies and unsupported statements in the book, it would be beyond the limits of this dissertation to cite further examples.

Edmonton's Electric Transit provides an extensive insight into the history of the streetcar and trolley bus in Edmonton. The numerous unsupported statements, as well as sketchy descriptions of technical terms and processes, tend to diminish the credibility of the book.

CHAPTER III

Track and Roadbed Construction

Initial Construction, 1907-1908

Well before the start of construction of the Edmonton Radial Railway (ERR), specific ideas and methods for track construction had been selected by City officials for possible use. The City Engineer's 1906 estimate for construction included a cross-sectional drawing of what the standard street railway roadbed would appear to be when completed, see Figure 1. A significant feature of that roadbed was the use of paving materials. At the time the estimate was made, no street in Edmonton was paved. Street paving began a year later, 1907, with the start of construction of Edmonton's street railway. (CEAR, 1908, p. 52) In order to accommodate large paving blocks, taller rails than normally used on conventional railroads were required.

In most instances, railroads that did not use paved roadbeds used T-type rails which conformed to the specifications of the American Society of Civil Engineers (ASCE). Rails which were designed specifically for street railways on paved streets were manufactured in two major types, high-T rail, sometimes referred to as Shanghai-T rail, and grooved girder rail. (Cyclopedia of Applied Electricity, Vol. III, pp. 84-85) Grooved girder rails will be discussed later in this chapter. High-T rail differs from the ASCE specifications in that the web of the high-T rail is taller and thinner. Figure 2 (after drawing of ERR Standard Rail Sections, December 1912) shows cross-sections of ASCE and high-T rail, both rails having a weight per yard of 80 pounds (33.2 kg/m).

The first rails ordered for the street railway, in early 1907, were

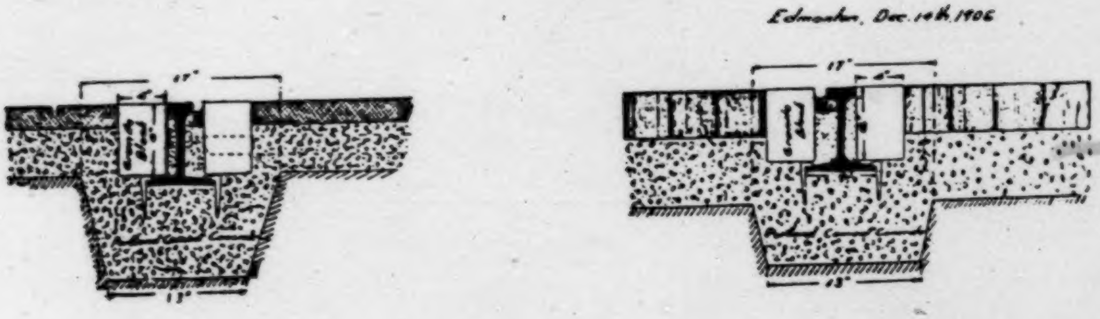
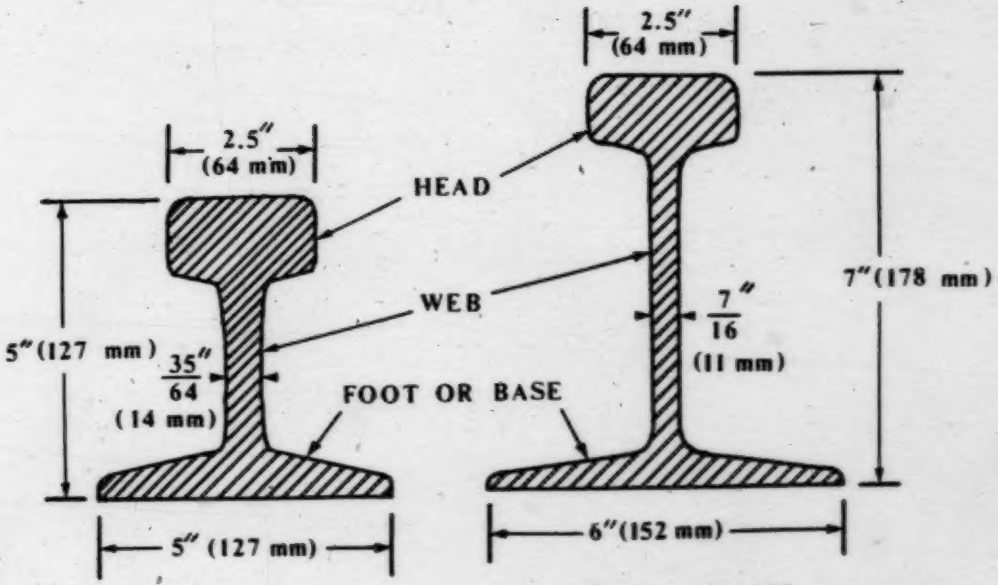

Edmonton, Dec. 14th 1906
17"
6"
13"

FIGURE 1. CROSS-SECTIONS OF PROPOSED TRACK CONSTRUCTION, 1906


2.5"
(64 mm)
HEAD
WEB
FOOT OR BASE
5"(127 mm)
35"/64
(14 mm)
5" (127 mm)
2.5"
(64 mm)
7"/16
(11 mm)
7"(178 mm)
6"(152 mm)

ASCE 80

LORAIN 80-335

FIGURE 2. T-RAIL CROSS-SECTIONS

the high-T variety, manufactured by the Lorain Steel Company of Johnstown, Pennsylvania. This rail was classified as 80-335. (The Railway and Marine World, 1907, February, p. 111) The "80" referred to the weight, in pounds, of each yard of rail. The "335" referred to the style of rail section produced by the company. (Lorain catalogue 22, Tramway Rails, 1927) Before rails could be laid, a suitable sub-grade and grade had to be prepared.

It had ultimately been decided by Edmonton City Council that the main sections of the street railway would be of double-track construction. With double-track construction, two sets of tracks are laid in the street, each set of tracks equidistant from the centre of the street. One set of tracks would be used by streetcars travelling in one particular direction. The other set of tracks would be used by streetcars travelling in the opposite direction. In May 1907, construction crews began preparing the roadbed by ploughing the centre portion of Jasper Avenue between First and Ninth Streets (101st and 109th Streets). This work was carried out by private contractors under the supervision of the City. (CEAR, 1908, pp. 50-51) It is a common belief that horses were the only means by which ploughing, grading or other construction equipment could be hauled. Photographs from that era show that horses were not used exclusively during the ploughing of Jasper Avenue. Plate 1 (City of Edmonton Archives) shows a crew ploughing Jasper Avenue at First Street (101st Street). To perform this operation, a steam roller is being used to pull the plough. As will be discussed in a subsequent section, steam powered devices were used in other aspects of street railway construction in Edmonton.

The sub-grade for double-track consisted of a trench approximately 22 feet 2 inches (6 756 mm) wide, excavated to a depth of approximately

Plate 1. (City of Edmonton Archives) Ploughing Jasper Avenue in 1907

8 inches (203mm) below the existing surface of Jasper Avenue. This sub-grade was not intended to bear the total weight of the rails. In order to support the rails further and in order to keep them at a pre-determined height, four rows of wooden spike blocks were set into the sub-base parallel to the sides of the trench. The rows of spike blocks were so placed that when the running rails were laid, the distance between the track centres would be 12 feet (3 658 mm). In each row of blocks, each block was placed so that it would lie directly beneath a running rail. Along each row, the individual spike blocks were spaced approximately 15 feet (4 572 mm) apart, and were held in place with concrete. (CEAR, pp. 51-52) The gauge, the distance measured between the facing sides of the rail heads, used for track laid on Edmonton's street railway was the standard 4 feet 8 1/2 inches (1 435 mm). To hold the running rails to this gauge, some sort of cross-tie had to be used. In the initial construction, steel ties were used. They were made from old 56 pound per yard (23.2 kg/m) T-rail that was cut into 6 foot (1 829 mm) lengths. (CEAR, p. 51) These "ties" were installed in an inverted position, perpendicular to the sides of the trench at intervals of 15 feet (4 572 mm). The ties were also placed so that they were midway between the spike blocks. Sections of running rails (Lorain 80-335), which were usually shipped in lengths between 30 and 33 feet (9 144-10 584 mm), were bolted together at the ends and were attached to the steel ties by clamps which were bolted in place. The running rails rested on the spike blocks previously set down in the sub-base. At this juncture, crews aligned the rails vertically using shims that were placed under the ties, and aligned the rails laterally by shifting the rails with pinch bars. After the rails were aligned, the crews attached the running rails to the spike blocks with ordinary railroad spikes. (CEAR, pp. 51-52) Plate 2 (City

Rail
Tie
Spike Block

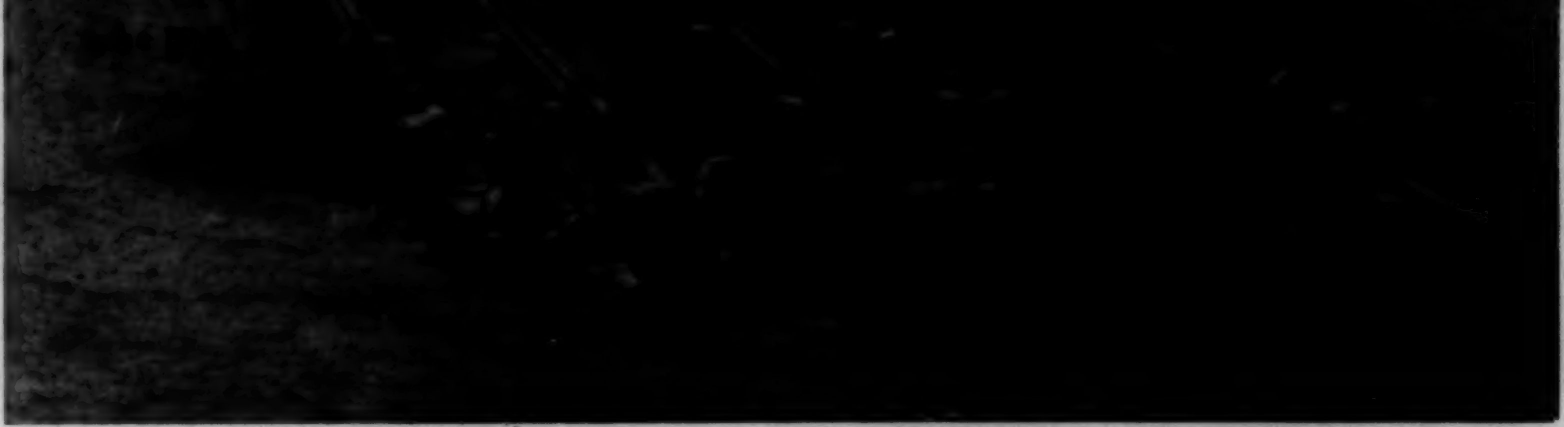


Plate 2. (City of Edmonton Archives) First Stages of Permanent Construction on Jasper Avenue, 1908

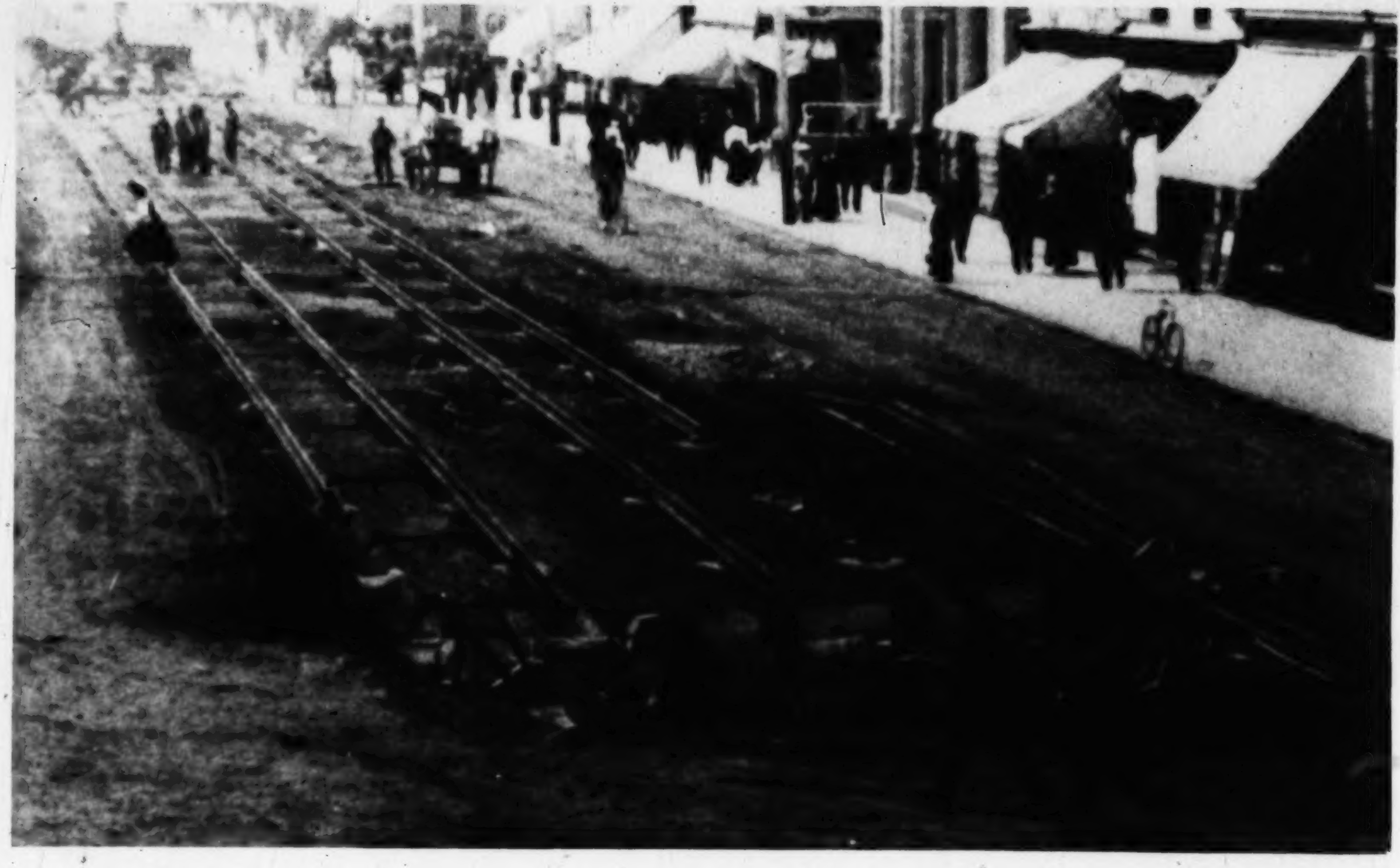


Plate 2. (City of Edmonton Archives) First Stages of Permanent Construction on Jasper Avenue, 1908

of Edmonton Archives) shows what the track construction looked like at this point. The spike blocks, steel ties and running rails are clearly visible in this plate and are labelled on the overlay.

In the next stage of the construction, concrete was poured into the trench and was tamped in and around the rails and ties and levelled so that approximately the upper half of the running rails remained exposed. (CEAR, 1908, p. 52) Plate 3 (Provincial Archives of Alberta) photographed in the fall of 1907 on Jasper Avenue just west of present-day 103rd Street, presents a clear view of track construction after the concrete had been poured. One should note the inverted rails used as steel ties. The large wire attached to the base of both running rails and labelled "cross-bond" on the overlay, was installed to enable the electricity used by the streetcars to return to the generating station evenly and with as little resistance as possible through both running rails. A more detailed discussion of cross-bonds may be found in a subsequent chapter.

The final step of the initial construction was to pave the street in order to provide an even, generally smooth surface for pedestrians and vehicles. The paving material selected for streets that had tracks was specially treated wood blocks. The blocks, referred to as "Carbolineum wood block", were treated with a carbolic acid compound which was supposed to retard their decay. (CEAR, 1908, p. 52) A major disadvantage of using these blocks was that it was necessary to lay them by hand. In consequence, large numbers of men were required to lay the paving blocks in order to make substantial progress. Plate 4 (City of Edmonton Archives) shows paving in progress in an easterly direction along Jasper Avenue between present-day 101st and 100th streets in mid 1908. In addition to the large crews required, special care was necessary when fitting the blocks near street railway tracks. The blocks were

Concrete
Clamp
Tie
Cross Bond
Rail
Angle Bar

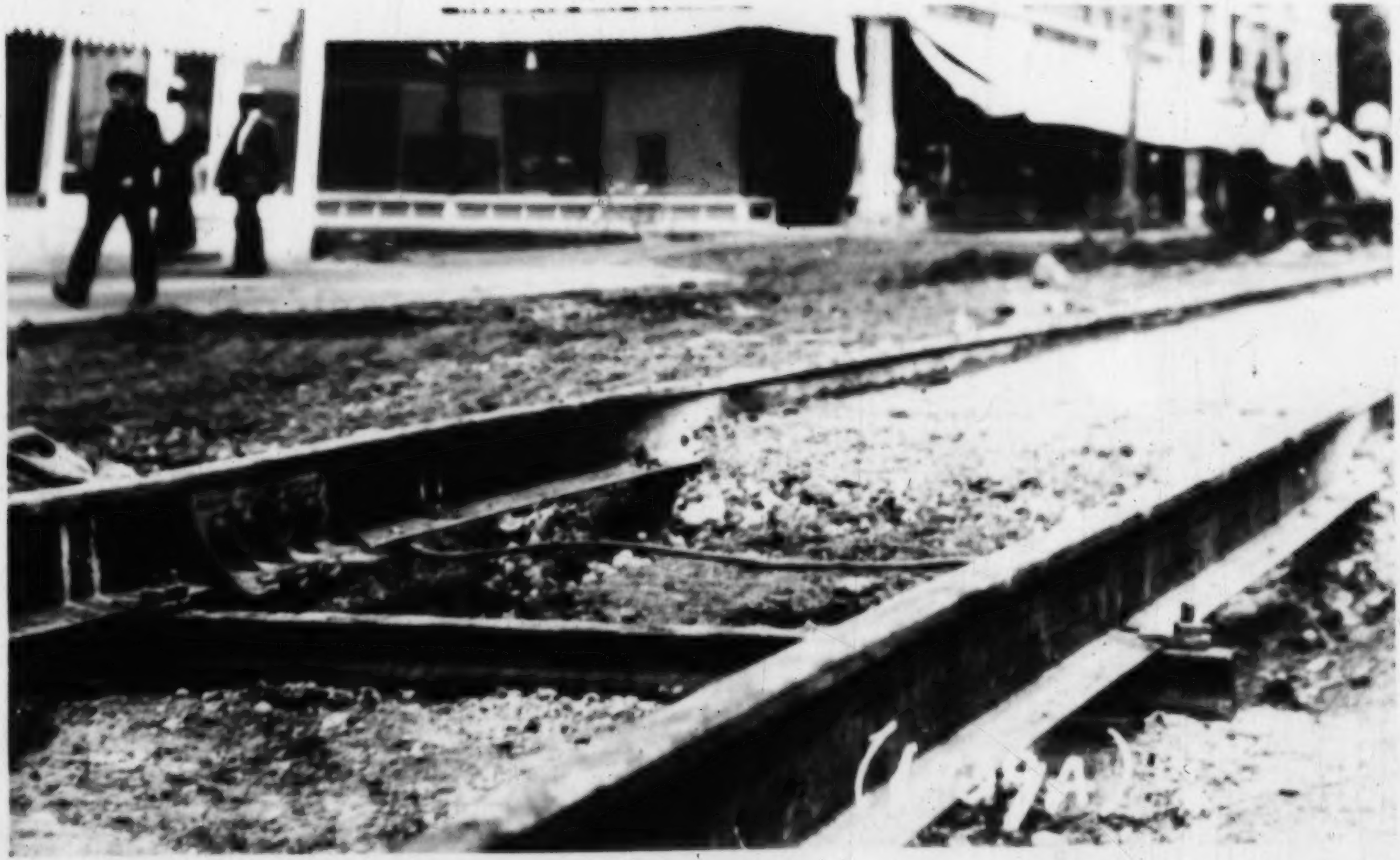


Plate 3. (Provincial Archives of Alberta) Detail of 1907 Permanent Construction

Concrete

Plate 3. (Provincial Archives of Alberta) Detail of 1907 Permanent Construction

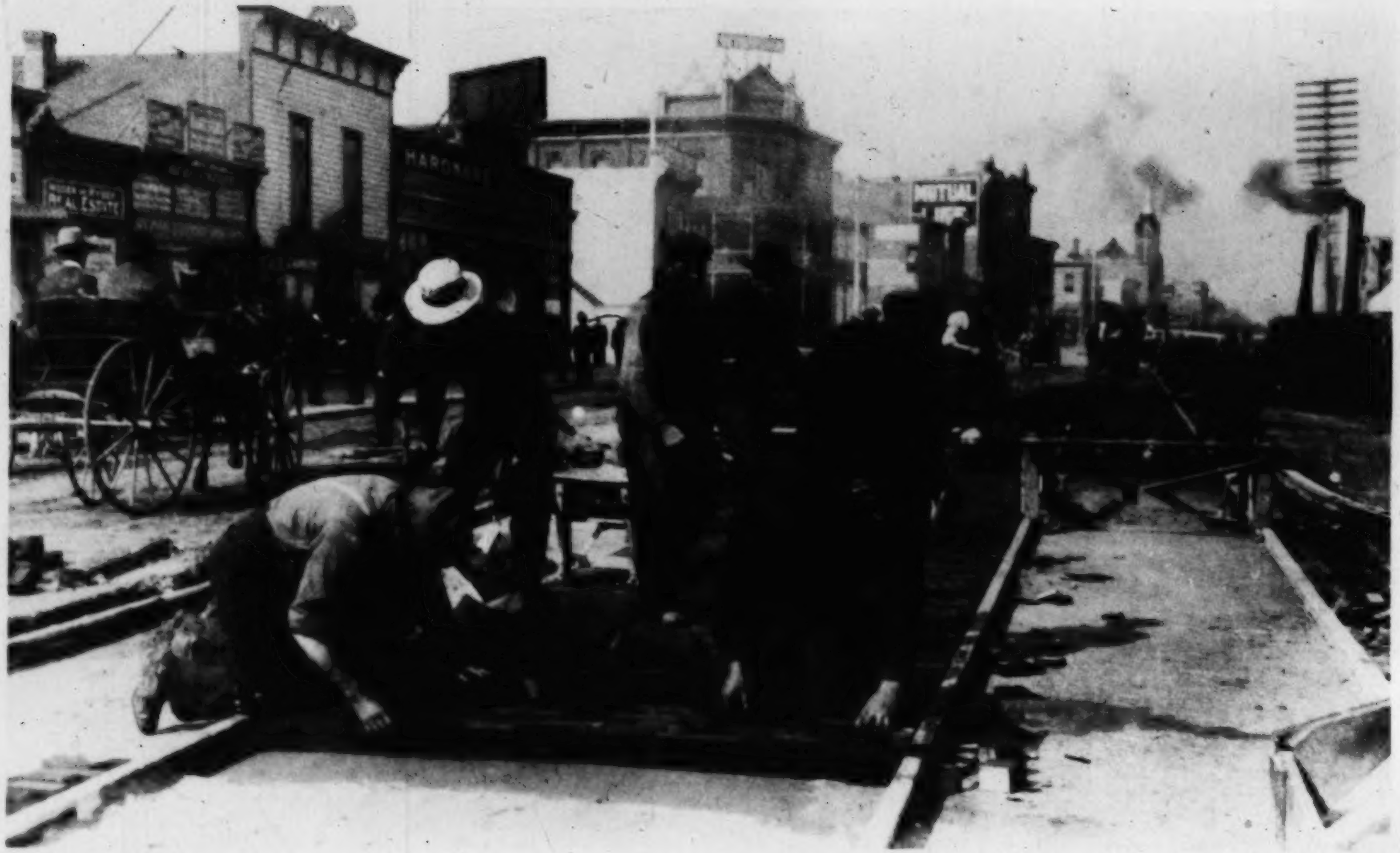

REAL ESTATE
MUTUAL

Plate 4. (City of Edmonton Archives) Crews Installing Wood Block Paving, 1908 designed to lie level with the tops of the running rails. Since most streetcars had flanged wheels, the edges of the blocks that were placed against sides of the rails where the flanges would pass had to be chamfered. If this was not done, the streetcar wheel would not remain on the head of the rail and the streetcar would probably leave the track. Once the paving was complete, the construction of the street railway track was considered finished. Figure 3 (based on descriptions in (CEAR, 1908, pp. 51-52, and Harding & Ewing, 1926, p. 285) shows a cross-section

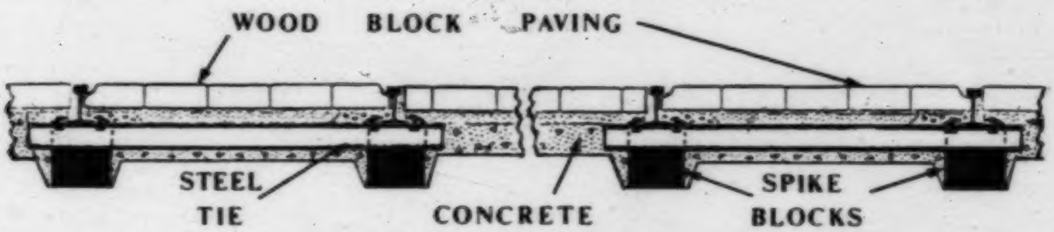


FIGURE 3. CROSS-SECTION OF DOUBLE-TRACK, 1907 STANDARD

through completed double-track built to the 1907 standard. This type of track construction was referred to, by city officials, as "permanent track". (CEAR, 1908, p. 51) A total of .58 miles (0.93 km) of permanent double-track was laid in 1907. An additional 1.303 miles (2.1 km) were laid in 1908.

To this point, the description and discussion of track and track laying has been limited to tangent (straight) track. Where tracks curved, branched off, crossed or intersected, special trackwork was required. Such trackwork was usually referred to as "special work". (Doane & Parkham, 1926, § 19 p. 32) Curved sections could normally be constructed locally, but switches and complex intersections were usually beyond the capabilities of most city shops. In addition, special hard-wearing steel alloys, usually manganese steel, were required for various pieces of the special work if it was to last more than a few years in service. (Doane & Parkham, § 19 pp. 35-36) In most instances, therefore, special work was constructed by various steel companies and by contractors. Prepared special work was usually shipped to its destination unassembled. It was eventually assembled by crews on its permanent site. By early 1907 it had been decided, by Edmonton City Council, that the double-track line to be constructed along Jasper Avenue would have a double-track branch-off to the north at First Street (101st Street). Map 1 shows the location of Jasper Avenue and First Street. The design of special work required for this type of intersection is known as a "three-part Y". (Doane & Parkham, § 19 p. 32) It consisted of six switches and eighteen frogs connected by sections of straight and curved track. A description of switches and frogs will be found in a subsequent section. When completed, the three-part Y, when looked at in plan view, resembled a capital letter "Y". The Falk Company, a contracting firm in Milwaukee, Wisconsin, fabricated the first three-part Y for the street railway. The special work arrived in 1907 and was installed during that year. (Correspondence between City Engineer, City Commissioners and the Falk Company, October 1907) A blueprint which showed the general appearance of the special work, in plan view, and which also included assembly instructions was sent as well. Figure 4 (after Falk Company blueprint showing construction layout of three-part Y at First and Jasper, May 1907) shows the general plan view of the three-part Y installed at Jasper Avenue and First Street. The arrows indicate the usual operations through a three-part Y.

The shape of the rail used in the construction of special work differed significantly from T-rail. Since most of the special work

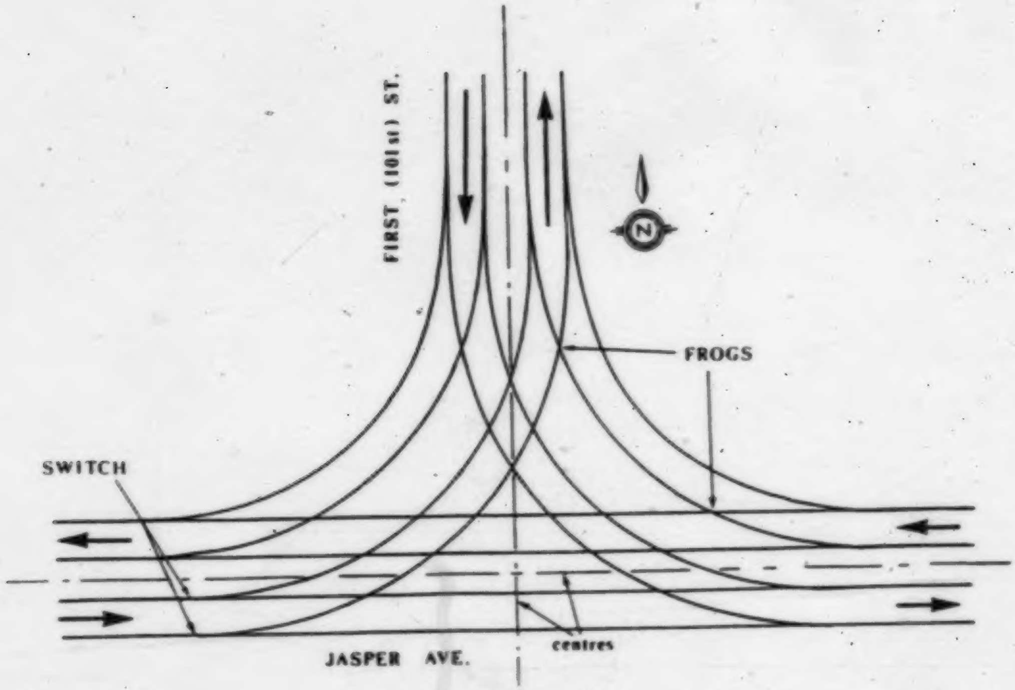


FIGURE 4. THREE-PART Y

consisted of curved sections of rail, it was necessary to use special rails which were designed to prevent the streetcar wheels from climbing the rails. Doane and Parkham (1926) wrote:

> When a car rounds a curve, the flange of the forward outer wheel presses against the gauge line [side of the head] of the outer rail. The contact of these two surfaces guides the car around the curve and causes a tendency for the wheel to climb the rail. . . . To prevent climbing, curves are laid with a guard feature which may be either part of the running rail itself or a separate rail laid alongside the running rail. (§ 19, p. 17)

In most special work used in Edmonton, the "guard feature" referred to was a type of grooved girder rail which had, as part of the side of the rail head, a high "lip" which was supposed to prevent the streetcar wheel flanges from climbing off the rail. This guard rail, which was usually the same height as the rails joining it, was heavier due to the weight of the lip. Two brands of grooved girder guard rail were used in special work constructed for Edmonton in 1907 and 1908. They were Lorain 108-398 and Hadfields D.K. 96c. It is important to note that the classification given for the Hadfields rail makes no reference to the weight of the rail, while the first three digits of the classification given for the Lorain rail signify the weight, in pounds, of 1 yard (0.91 m) of rail. The Lorain rail, manufactured in the United States had a weight per yard of 108 pounds (44.8 kg/m). The Hadfields rail, manufactured in Sheffield, England, had a weight per yard of 110 pounds (45.6 kg/m). (Hadfields Steel Foundry cross-sectional drawing of D.K. 96c guard rail, 1911) The heavier weight of the Hadfields rail was due to it having a slightly wider and thicker head than the Lorain rail. Figure 5 (after drawing of ERR Standard Rail Sections, December 1912) shows cross-sections of Lorain 108-398 and Hadfields D.K. 96c grooved girder guard rails with the major parts identified.

The method used to install special work was somewhat different than the method described for installing tangent track. Once the trench had been excavated and the spike blocks set, large, widely-spaced wooden ties were placed in the trench. The pieces of the special work were then placed in the trench on top of the ties. To facilitate assembly, each piece of the special work was numbered by the manufacturer. Assembly began with the crews matching the numbers on the ends of the various pieces. If this was done correctly it was unlikely that the special work would be incorrectly assembled. Once all the parts were accounted for and matched, the pieces were bolted together at the ends. Plate 5 (City of Edmonton Archives) shows crews assembling the three-part Y at Jasper Avenue and First Street in 1907. The photograph was taken on Jasper Avenue looking north on First Street. The numbers on the sides of the special work pieces as well as the wooden ties should

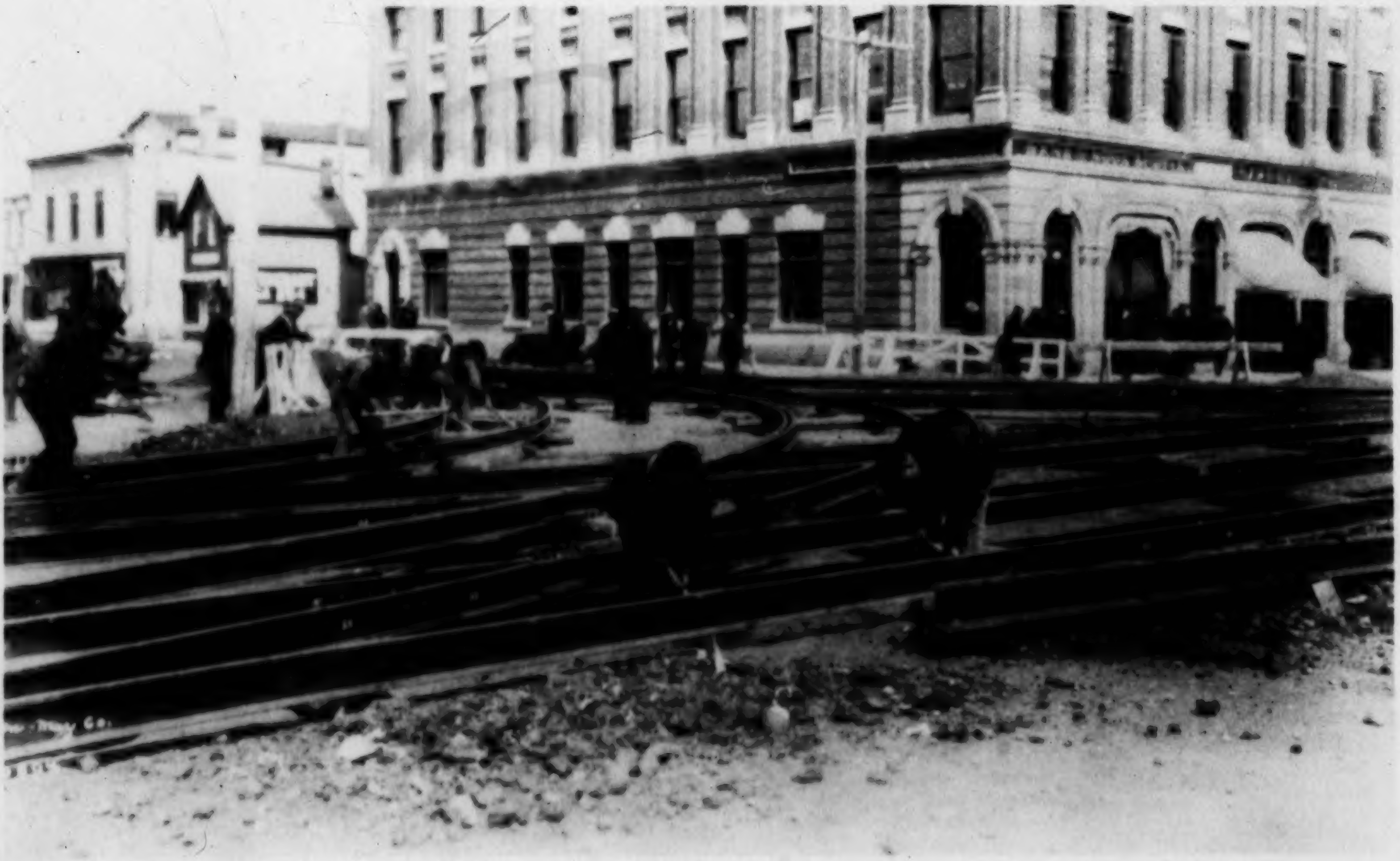
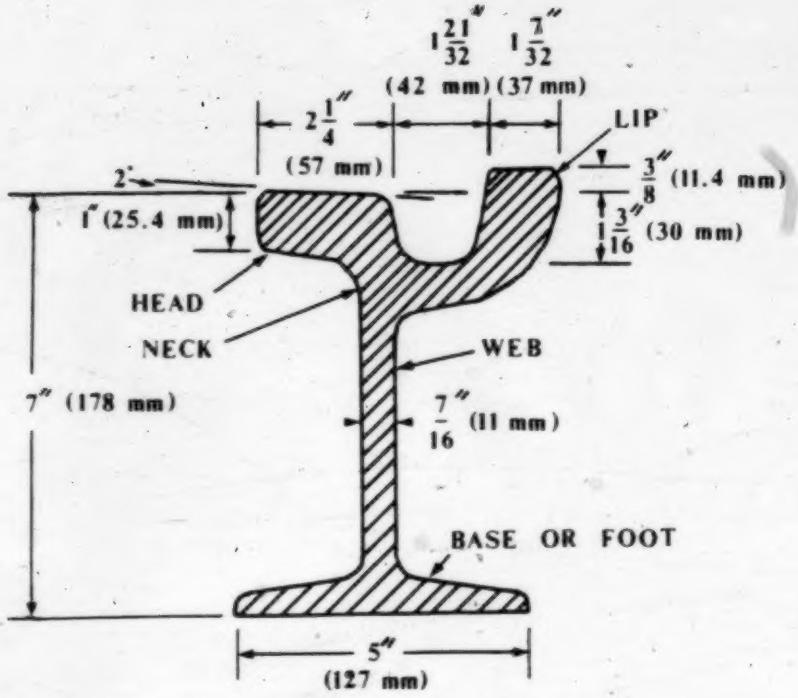
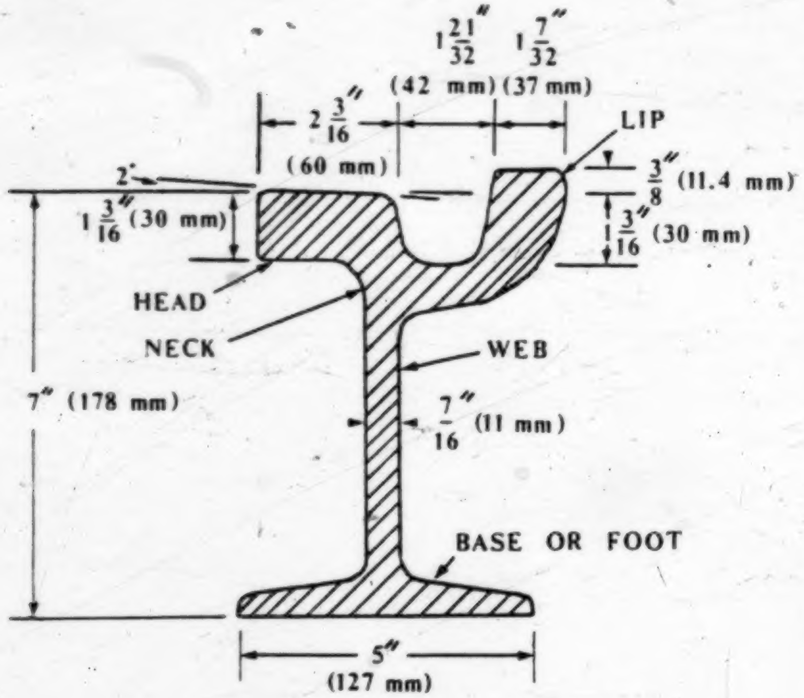


Plate 5. (City of Edmonton Archives) Three-Part 'Y on Jasper Avenue and First Street, 1907


1 21/32″
1 7/32″
(42 mm)
(37 mm)
2 1/4″
(57 mm)
LIP
3/8″ (11.4 mm)
1 3/16″ (30 mm)
2°
1″ (25.4 mm)
HEAD
NECK
WEB
7″ (178 mm)
7/16″ (11 mm)
BASE OR FOOT
5″
(127 mm)

LORAIN 108–398


1 21/32″
1 7/32″
(42 mm)
(37 mm)
2 3/16″
(60 mm)
LIP
3/8″ (11.4 mm)
1 3/16″ (30 mm)
2°
1 3/16″ (30 mm)
HEAD
NECK
WEB
7″ (178 mm)
7/16″ (11 mm)
BASE OR FOOT
5″
(127 mm)

HADFIELDS D.K.96c

FIGURE 5. GUARD RAIL CROSS – SECTIONS

be noted. When all sections were bolted together, the ends of the special work assembly were aligned with the ends of the tangent track leading to the special work. The assembled special work was then bolted to the ends of the tangent tracks and spiked to the spike blocks and to the wooden ties. Concrete was poured in and around the special work and was levelled so that approximately the upper half of the rails remained exposed. When the concrete had set sufficiently, wood block paving was installed in the same manner as that previously described for tangent track. Special work constructed in this manner was considered to be "permanent work". (CEAR, 1908, pp. 51-52) Only one other piece of permanent special work was installed during the initial construction of 1907 and 1908. It was a three-part Y located at the intersection of Jasper and Namayo Avenues (97th Street).

It was mentioned earlier in this section that guard rails were required on curves in order to prevent the streetcars' wheels from climbing off the rail. It was also stated that the curved sections of grooved girder guard rail for special work arrived already bent to the proper radius. The construction of permanent track curves, other than those in special work, presented some problems. Most street railways had the tools necessary to bend properly ASCE and high-T rail into curved sections, but very few properties had the facilities and equipment to bend grooved girder guard rail properly. It was possible to order custom fabricated curved guard rail sections from the manufacturers, but this was costly. A cheaper alternative was to bend the ASCE or the high-T rail to the proper radius and then to affix a pre-fabricated rolled-steel guard to the web of the rail using bolts. The pre-fabricated guard was known variously as "T-guard rail" (Doane and Parkham, 1926, § 19 p. 18), and as "'D' guard". (Drawing of ERR Standard Rail Sections, December 1912)

The "D" guard, as it was known in Edmonton, consisted of two parts. The lip, which provided the flangeway and guard and a support bar which, when bolted to the web of the rail, held the lip tightly against the underside of the head and to the web of the rail. Figure 6 (after drawing of ERR Standard Rail Sections, December 1912) shows a cross-section of Lorain 80-335 high-T rail with "D" guard attached. The dimensions and names of the guard pieces are indicated. (See figure 2 for dimensions and names of parts for Lorain 80-335 rail) The first use of "D" guard was on the double-track curves on Jasper Avenue at Queens Avenue (99th Street). Map 3 (after: Mundy's Street Index Map of Edmonton, 1915; Official Map of the City of Edmonton, 1938; CEAR, 1908, pp. 51-52, 81; CEAR, 1909, pp. 100-102) shows the extent and location

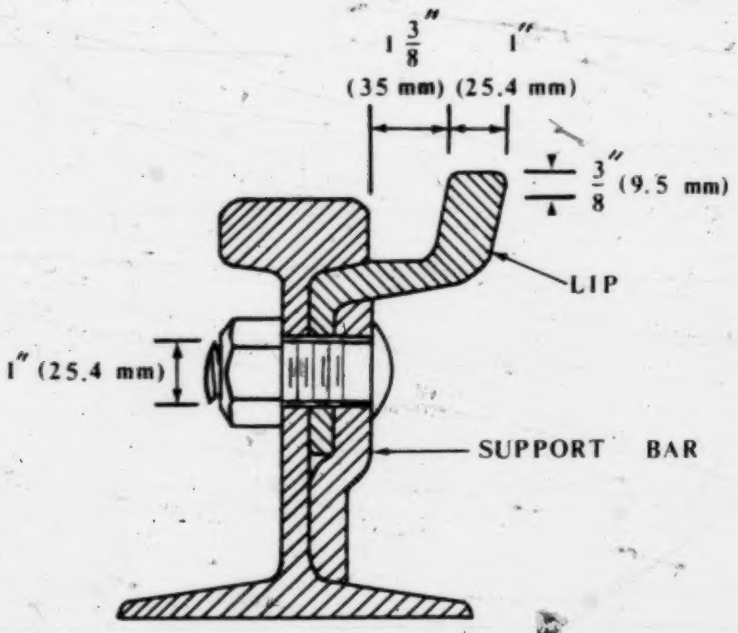
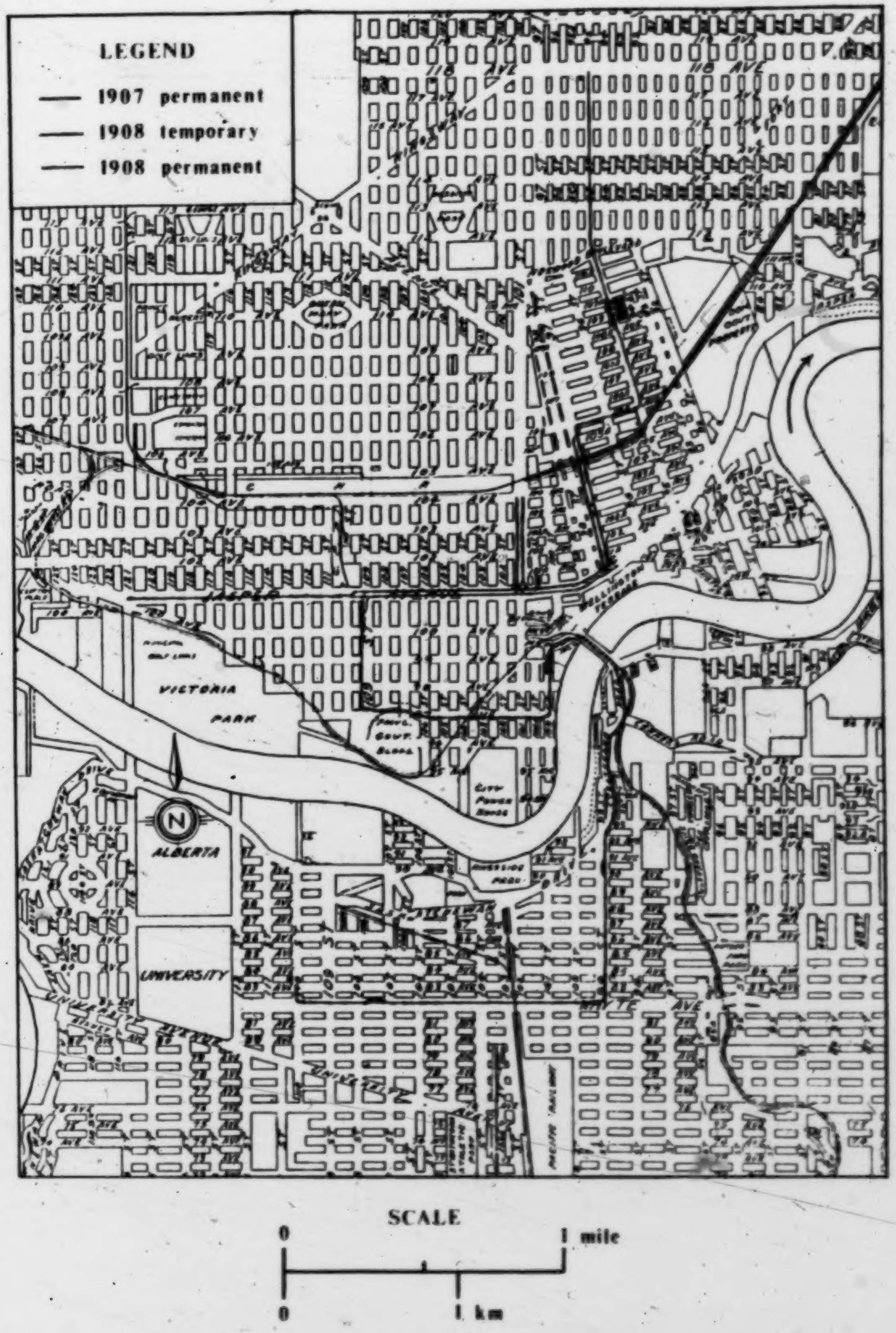


FIGURE 6. CROSS-SECTION OF LORAIN 80-335 WITH "D" GUARD

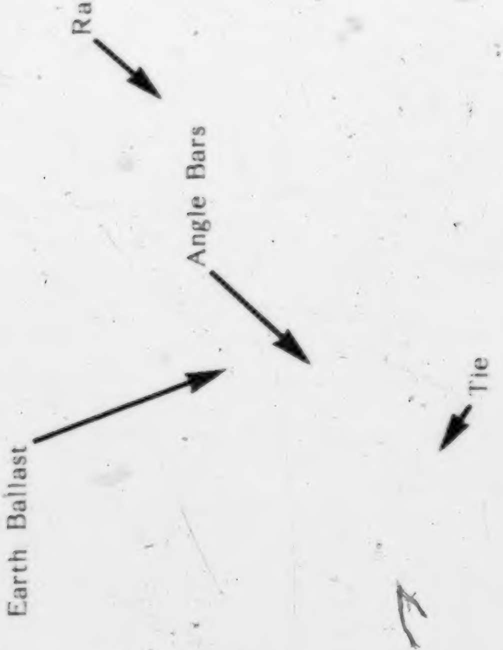

LEGEND
1907 permanent
1908 temporary
1908 permanent
118 AVE
JASPER
C N R
WELLINGTON TERRACE
VICTORIA
PARK
PROV. GOVT. BLDGS
CITY POWER HOUSE
N
ALBERTA
UNIVERSITY
WHYTE AVE
SCALE
0
1 mile
0
1 km

MAP 3. EXTENT & TYPE OF CONSTRUCTION 1907–1908 of permanent track constructed in 1907 and 1908.

Temporary Construction, 1908

Permanent double-track was not the only type of track constructed before the start of streetcar operation in November 1908. Although only permanent double-track was constructed in 1907 and in the first seven months of 1908, a substantial distance of single and double "temporary track" was constructed between August and November 1908. (CEAR, 1908, p. 81) The term "temporary track" referred to either single- or double-track laid with ASCE section rails, usually 60 pounds per yard (24.9 kg/m), spiked to wooden ties. The roadbed consisted of graded, unpaved streets. The track was held in place with a mixture of earth and gravel ballast. (CEAR, 1909, p. 97) The ties that were used for this construction differed in size and shape from the standard street railway wooden tie. Doane and Parkham (1926, § 19 p.6) as well as several Edmonton Radial Railway track cross-sections dating from 1910, describe the standard street railway tie as having a length of 8 feet (2.44 m), a width of 8 inches (203 mm) and a height of 6 inches (152 mm). Most wooden ties used in Edmonton were sawn from fir, tamarack (larch) or spruce logs. In the 1908 temporary track construction, however, only two parallel faces were sawn on logs destined to be ties. No creosote or other preservative was used. The half-sawn ties were then placed on the graded road at intervals of about 2 feet (610 mm). The rail was then placed directly onto the ties, no tie plates were used. The rail sections were bolted together at the ends using standard angle bars and bolts. This method was similar to that used to connect sections of high-T rail in permanent work. A notable difference in temporary track, however, was that the joints in each rail were so placed that they were not opposite joints in the other rail. It was intended that each joint would be across from the centre of the rail-section of the opposite rail. Track that employed this type of rail joint location was commonly referred to as being "broken jointed". (Doane & Parkham, § 19 p. 26) Once the rail sections were properly bolted together, the ties were re-spaced so that there was a tie on either side of a joint, each tie being placed as close as possible to the centre of the joint. No tie, however, was placed directly beneath the centre of the joint. The joints were, therefore, commonly referred to as "suspended joints" because the rail sections met between ties. (Doane & Parkham, § 19 p. 26) With the aid of a track gauge and spike mauls, crews were able to spike the rails to the ties by hand. The use of a track gauge ensured that the rails were kept to the proper gauge. Ballast was then deposited on the track by horse-drawn wagons, and crews tamped it in place between and under the ties. The ballast was also distributed so that it sloped down from the centre of the track towards the ends of the ties. When ballasting was finished, the construction was considered to be complete. Plate 6 (Provincial Archives of Alberta) shows some temporary track that was laid using the aforementioned methods. The photograph was taken in the fall of 1908 in the City of Strathcona. The photographer was facing north on 5th Street North-East between 9th and 10th Avenues North-East (now known as 99th Street between 91st and 92nd Avenues, see map 1 for locations). The location of the rail joints, the spacing of the ties and the ballast should all be noted.

There appears to have been two major factors in the decision to switch from permanent to temporary construction. One factor was financial considerations. As early as October 1907, it was known that the City of Edmonton was running short of money. (Letter from Mayor


Rail
Angle Bars
Earth Ballast
Tie

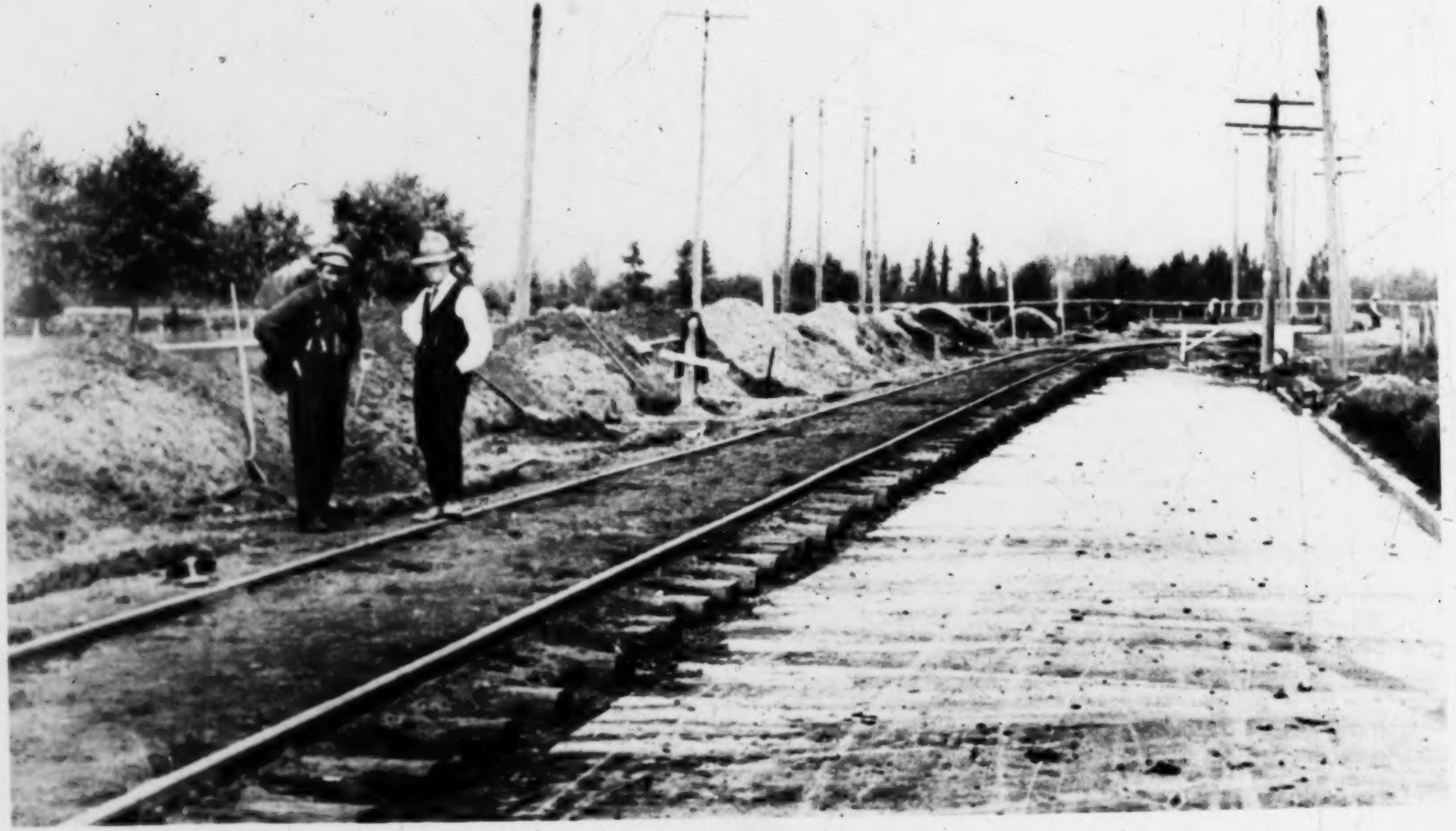


Plate 6. (Provincial Archives of Alberta) Temporary Track in Strathcona, 1908

Earth Ballast

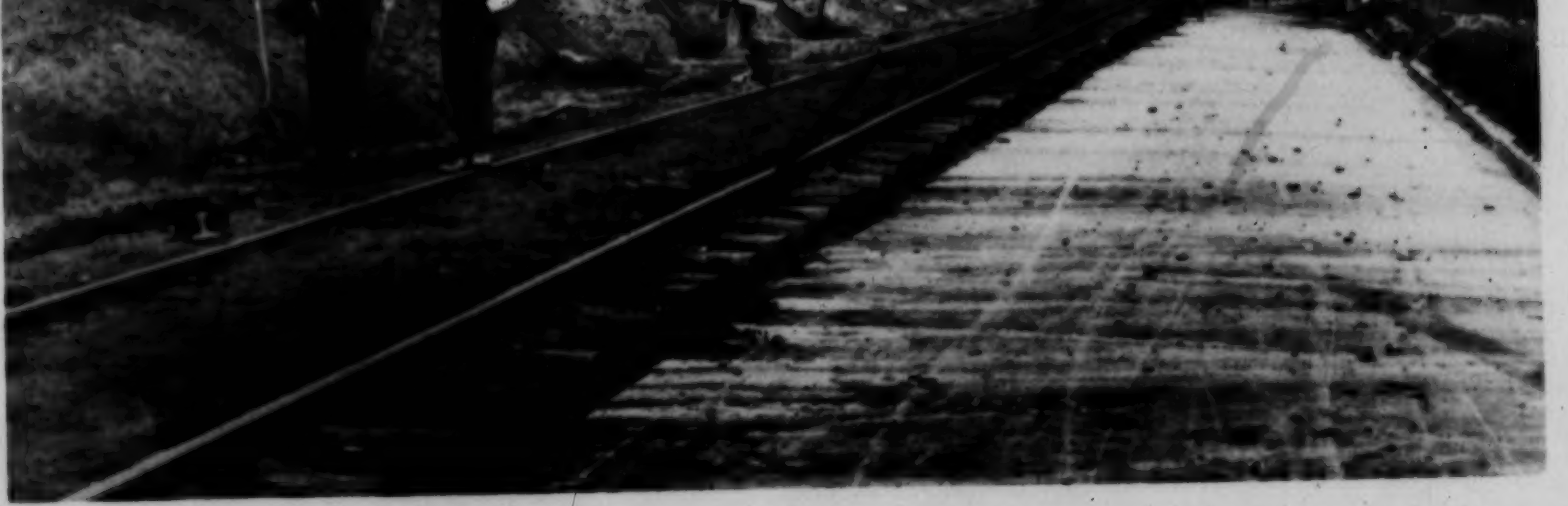


Plate 6. (Provincial Archives of Alberta) Temporary Track in Strathcona, 1908

W. A. Griesbach to "Public Service", October 16, 1907) While permanent track provided an ideal track, it was expensive and slow to construct. Temporary track, while not as substantial and esthetically pleasing as permanent track, was cheaper to construct and could be built faster. In addition, the City of Edmonton purchased the Strathcona Radial Tramway Company in August 1908 and agreed to construct an interurban line from Edmonton to various points in the City of Strathcona (see Chapter II for background of the Strathcona Radial Tramway Company). At this juncture, the street railway under construction in Edmonton and soon to be extended to Strathcona, became known variously as the Edmonton Radial Railway (ERR), or the City of Edmonton Street Railway Department. (City of Edmonton Bylaw 184, August 1908) A superintendent, Charles E. Taylor, was appointed at this time as well. Taylor had the authority to order equipment and supplies and to decide on what construction methods to be used, subject to the approval of the City Commissioners. (City of Edmonton Minutes of Council, Meeting 42, August 4, 1908)

A grand total of 6.71 miles (10.8 km) of temporary track was constructed in 1908. The figure is based on the total length of all temporary track laid, calculated as single-track. Lengths of double-track would, therefore, be added twice. Only 600 feet (183 m) of double-track, 1,200 feet (366 m) if counted as single-track, was constructed in that year. It was laid on Namayo Avenue (97th Street) from Isabella Street (104th Avenue) to Griesbach Street (105A Avenue). (CEAR, 1909, p. 100) Since the interurban line was all single-track construction, passing tracks (turnouts) were installed at several locations to enable streetcars travelling in opposite directions to pass each other. Map 2 (after Official Map of the City of Edmonton, 1938, and drawing Showing Position of Poles and Track, 1908) shows the location and extent of temporary track constructed in 1908. The passing tracks on Syndicate Avenue (95th Street) and on Curry (100th) Street in Edmonton, as well as those on Fifth (99th) Street and on Whyte (82nd) Avenue in Strathcona should be noted. As well, the frequent location of the track near the side of the road should be noted. There appears to be two possible explanations as to why this was done. By placing the temporary track at the side of the road, there would be minimal interference with vehicular traffic since the tracks were not paved. The other explanation is that the ERR anticipated replacing the temporary track with permanent double-track at an early point in the future. By having the temporary track at the side of the road, construction of the permanent track in the centre of the road could take place without disrupting streetcar service. Support for both explanations will be found in subsequent sections of this chapter.

Special work in temporary construction included crossings, branch-offs (switches) and frogs. In addtion, a left hand crossover was installed on Jasper Avenue immediately west of Ninth (109th) Street. A crossover was a unit of special work which enabled a streetcar, travelling in a certain direction on a double-track line, to cross from the track it was on, over to the other track. Crossovers were used mainly to enable double-end streetcars (streetcars that could be operated from either end) to keep on the proper side of the road when they reversed their direction of travel. In addition, crossovers were also used to divert streetcars from one track to the other in emergencies or when one track was blocked. (Doane & Parkham, 1926, § 19 p. 32) There were two major types of crossovers used on Edmonton's street railway. Left hand, which enabled streetcars to change tracks while travelling forward, and right hand, where streetcars had to reverse direction in order to change tracks.

Figure 7 (after plan of ERR Standard 10 ft. crossover, June 1913) shows the general appearance, in plan view, of a standard right hand crossover.

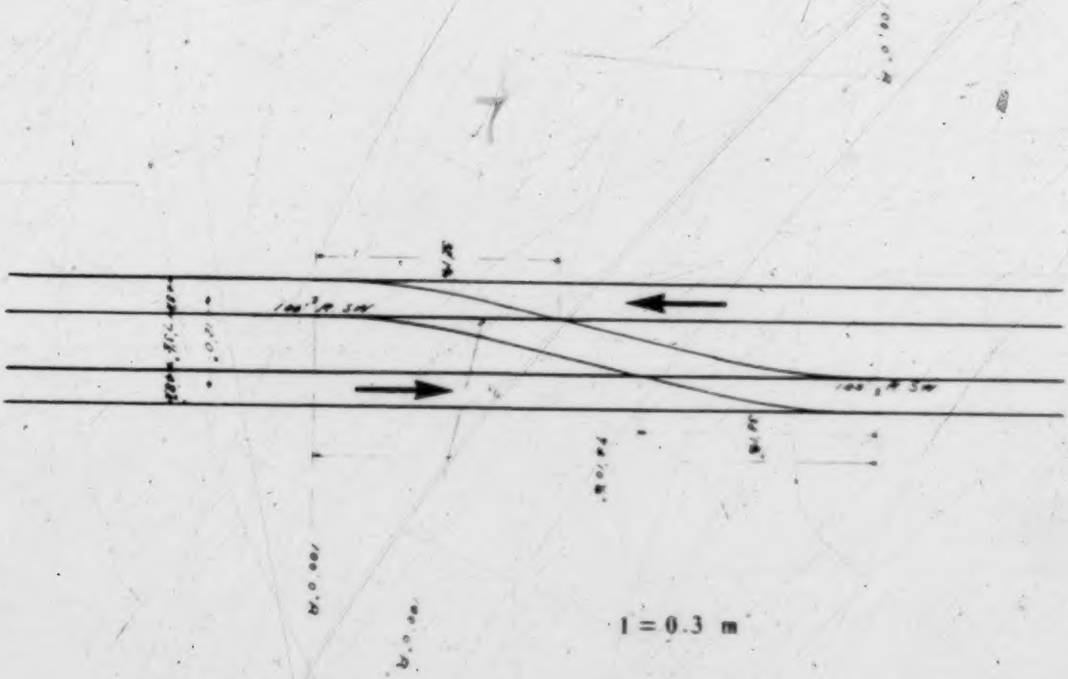


FIGURE 7. PLAN OF RIGHT HAND CROSSOVER

An unusual feature was the special track laid across the Saskatchewan Bridge (now the east half of the Low Level Bridge). The bridge was originally built to carry the Edmonton, Yukon and Pacific Railway (EY&PR) (now part of Canadian National Railways; bridge portion abandoned) vehicles and pedestrians across the North Saskatchewan River. The railroad track was placed in the centre of the bridge. Any alteration or expansion by a chartered railroad was subject to the approval of a Federal regulatory agency known as the Board of Railway Commissioners

(BRC), now the Canadian Transport Commission. The BRC also had some jurisdiction over most Canadian street railways. Whenever a street railway wished to cross a railway chartered by the Federal Government, the street railway had to submit plans of the proposed crossing to the BRC for approval. The street railway, furthermore, could not legally use the crossing until approval was granted. It should be noted that the BRC could refuse approval, or could order changes to be made. (Letter to C. E. Taylor from J. Bown, City of Edmonton Solicitor, November 25, 1909). On November 24, 1908, the BRC gave its approval to the ERR's proposal to cross the EY&PR and to use the west side of the Saskatchewan Bridge. (Board of Railway Commissioners' Order No. 5691, November 24, 1908)

The bridge deck was 18 feet (5.49 m) wide. It was felt by the City Engineers and by the Superintendent of the ERR that if the street railway track was laid near one side of the bridge, there would be enough space for a wagon to be on the bridge while a streetcar was crossing. (Drawing of Vertical Sections Through Bridge Showing Position of Cars, August 1908) Since there was not enough space on the deck of the bridge to place another set of tracks next to the railroad track, the ERR track was so placed that, at either end of the bridge, one rail crossed the western rail of the EY&PR and travelled between the rails of that railroad. This arrangement was known as "gauntlet track". (Doane & Parkham, 1926, § 19 pp. 36-37) It should be noted that wooden planks were placed around and between the rails on the bridge in order to provide a smooth surface for road vehicles. Figure 8 (after drawings Showing Position of Poles and Track in Edmonton and Strathcona, 1908, and Provincial Archives of Alberta photograph A.1387) shows the plan view of the gauntlet track constructed across the Saskatchewan Bridge.

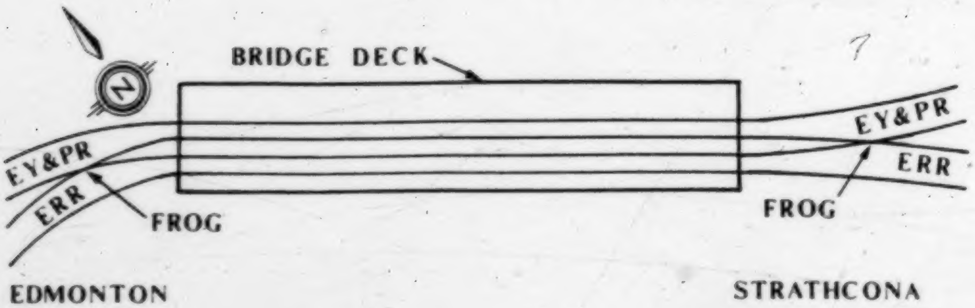


FIGURE 8. PLAN OF GAUNTLET TRACK ON SASKATCHEWAN BRIDGE

It can be seen in Figure 8 that the ERR rail crossed the EY&PR rail by means of frogs. These frogs, and those mentioned earlier in this chapter, were pieces of fixed special work which enabled two rails to cross at angles less than 90°. The frogs consisted of four pieces of T-rail bolted or riveted to a supporting plate which held the rails to the correct angle and which provided a flangeway for the wheels. The rails were also formed so that they provided a smooth and even crossing for the wheels. Figure 9 (after drawing of Standard Riveted Plate Frog, August 1908) illustrates the general appearance of the type of frogs used on the ERR in 1908.

Permanent Construction, 1909

The method and the materials of construction that were used in 1909 differed from those used previously. The first step in the new construction of permanent track began with contracting crews excavating a flat-bottomed trench in the centre of the road to a depth of approximately 22 feet 2 inches (6 756 mm). A 4 inch (102 mm) layer of concrete was then deposited and smoothed along the bottom of the trench.

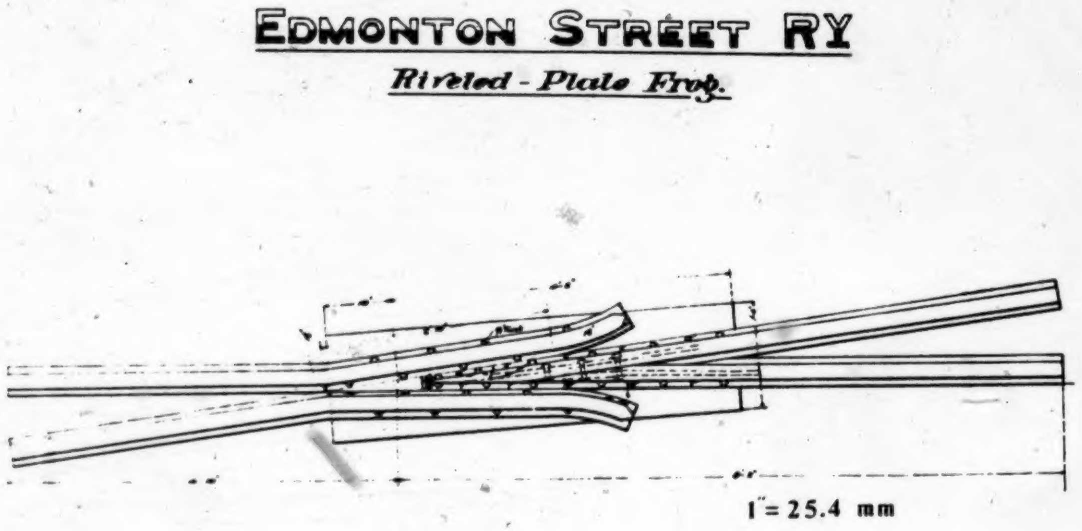
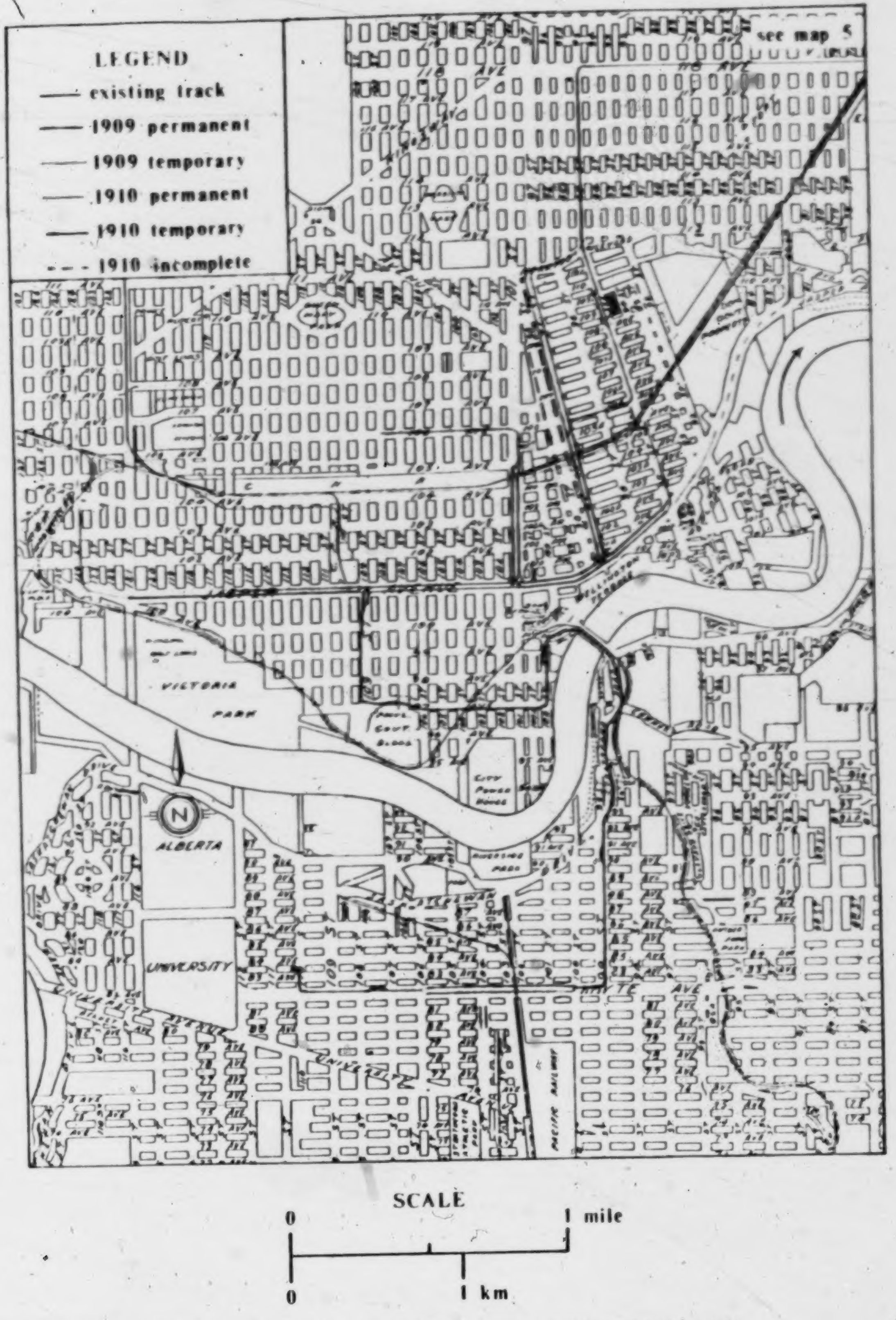


FIGURE 9.

When the concrete had hardened sufficiently, wooden ties were placed on the concrete perpendicularly to the edges of the trench at intervals of approximately 2 feet (610 mm). The ties, made from fir, spruce or tamarack, were cut to a length of 8 feet (2.44 m), a width of 8 inches (203 mm) and a height of 6 inches (152 mm). Lengths of 80 pounds per yard (33.2 kg/m) ASCE T-rail were then placed directly on the ties. The rail lengths were bolted together at the ends and the rails were then gauged and spiked to the ties. The track centres were 12 feet (3 658 mm) apart. Concrete was then deposited in the trench and was levelled with the tops of the rail heads. In addition, flangeways were formed in the concrete before it hardened. (CEAR, 1909, p. 97, and drawings of Sections of Track Construction, 1909-1913) Although this method of construction was less expensive than that used in 1907 and 1908 because of the use of wooden ties and ASCE-section rail, there was another reason why the 1907-1908 method was not continued. The carbolineum wood-block paving used in the initial construction had swelled when exposed to moisture and, in some instances, had risen from the concrete bed and interfered with the operation of the streetcars. The condition became so severe that the blocks were removed from between the rails and tracks on Jasper and Namayo Avenues (97th Street). (CEAR, 1909, p. 97) The use of concrete as a paving material in the 1909 construction eliminated this problem. It was not feasible, however, to pave the entire street with concrete, because the extreme temperature fluctuations in the City coupled with heavy traffic on paved streets would cause the concrete next to the rails to crack. The road surface would, therefore, become rough and uneven. It should be noted that the concrete used in the 1909 construction did not have any internal reinforcing and expansion joints were not used. In the 1909 Annual Report, Superintendent Taylor wrote,

> This form of construction has been used in many parts of America with good satisfaction but for heavy City traffic the Department [Street Railway Department or ERR] will for future track laying have to secure either granite sets or paving brick for use between the road paving and the rail. (p. 97)

A total of 0.71 miles (1.14 km) of permanent double-track was constructed in 1909. The distance is equivalent to 1.41 miles (2.27 km) if the construction is reckoned as single-track. (CEAR, p. 101) The distance of permanent double-track constructed in 1909 was less than the distance constructed in 1908. In addition, most of the 1909 permanent track was constructed on Whyte (82nd) Avenue in Strathcona, replacing the temporary track laid in 1908. The remainder of the 1909 permanent construction extended double-track lines constructed previously. Map 4 (after Official Map of the City of Edmonton, 1938, and (CEAR, 1909, p. 101) shows the location of permanent double-track constructed in 1909.


LEGEND
existing track
1909 permanent
1909 temporary
1910 permanent
1910 temporary
1910 incomplete
see map 5
VICTORIA PARK
PROV. GOVT. BLDGS
CITY POWER HOUSE
ALBERTA
UNIVERSITY
PACIFIC RAILWAY
N
SCALE
0
1 mile
0
1 km

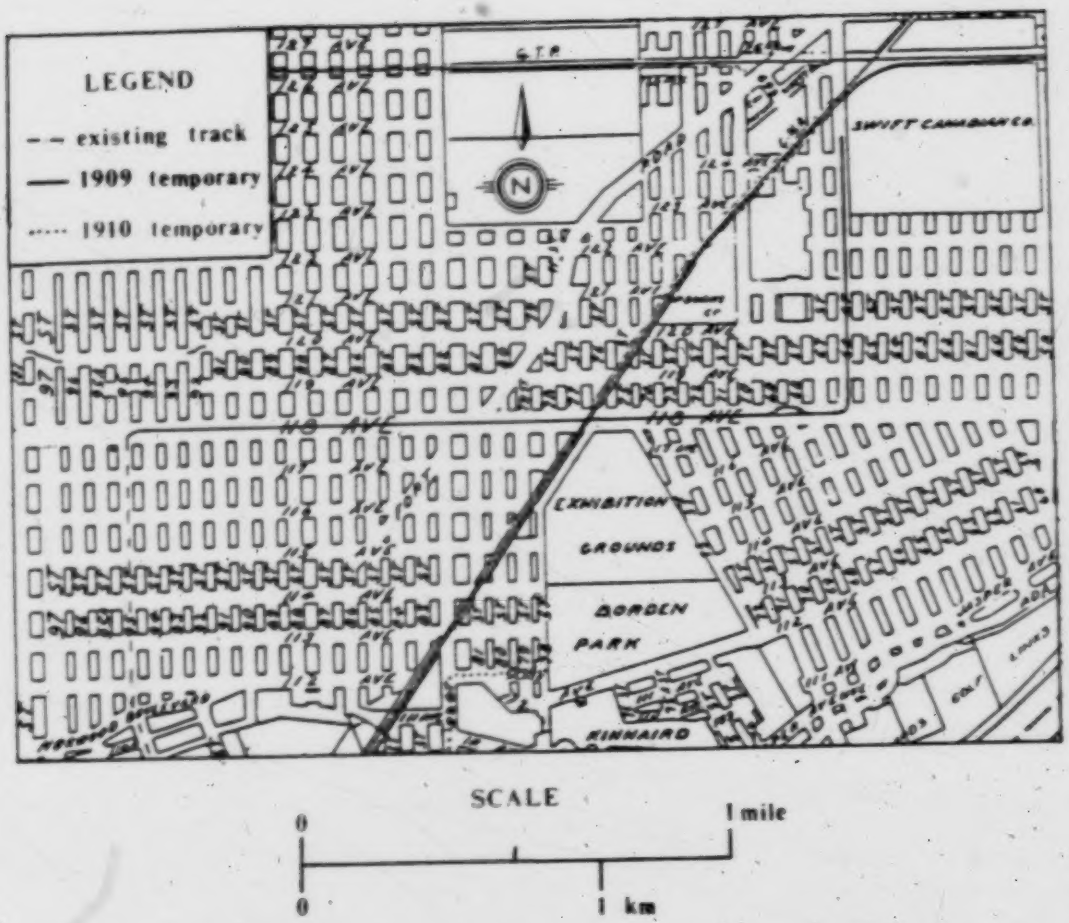
MAP 4. EXTENT & TYPE OF CONSTRUCTION 1909 – 1910

Temporary Construction, 1909

The methods used for the construction of temporary track in 1909 were quite similar to those described for 1908. It appears, however, that the ballast used in 1909 consisted solely of gravel. (CEAR, p. 97) Calculated as single-track, the total distance of temporary track constructed in 1909 was 4.27 miles (6.87 km). (CEAR, p. 102) Of that distance, 250 feet (76.2 m) of double-track (not counted as single-track) and 730 feet (222.5 m) of single-track was constructed by ERR crews with assistance and guidance from the City Engineers. This construction was located on First (101st) Street between the railroad crossing and Vermilion (106th) Avenue. This was the first occasion when City crews undertook construction of track, including the roadbed. (CEAR, p. 102) Maps 4 and 5 (both after Official Map of the City of Edmonton, 1938, and CEAR, 1909, p. 102) show the location of temporary track constructed in 1909.

Freight Track, 1909

The ERR could carry freight as well as passengers. Although freight could be transported along the same tracks as passengers, the origins and destinations of freight usually differed from those of passengers. Where volume, frequency or weight warranted, a special track could be constructed from a passenger track to an appropriate location for the sole purposes of collecting or delivering freight. These freight only tracks were constructed in a manner similar to the method used in the construction of temporary passenger track. It has been mentioned, in previous sections, that much of the material for track construction was not manufactured locally. These materials were usually brought and


LEGEND
-- existing track
— 1909 temporary
..... 1910 temporary
G.T.P.
SWIFT CANADIAN CO.
N
118 AVE
EXHIBITION GROUNDS
BORDEN PARK
KINNAIRD
GOLF
SCALE
0
1 mile
0
1 km

MAP 5. NORTHEAST CONSTRUCTION, 1909–1910

delivered by rail to the City at their yard, which was located north of Clark Street (105th Avenue) between Kinistino and Syndicate Avenues (96th and 95th Streets). To assist with the movement of construction materials to the ERR, a single freight track was constructed from the single-track line on Syndicate Avenue (95th Street) at Clark Street (105th Avenue) into the City yard. (Edmonton Evening Journal, 1909, April 15, p. 8) Access to the freight track was provided by a left hand branch-off (switch) located on Syndicate Avenue (95th Street) at Clark Street (105th Avenue). Map 4 (after Official Map of the City of Edmonton, 1938, and Driscoll's and Knight's Map of Edmonton, 1909) shows the location of the freight track into the City yard.

Reconstruction, 1910

In a previous section which described 1909 permanent track construction, it was mentioned that the carbolineum wood-block paving used in the 1907-1908 permanent construction rose from the concrete base and was, consequently, removed from Jasper and Namayo Avenues (97th Street) during that year. The problem with the blocks first became apparent during the spring thaws of 1909. When the ambient temperature rose during the day and caused some of the snow to melt, some of the melt-water entered the spaces between the blocks and collected on top of the concrete base. When the temperature dropped to below freezing, at night for example, the water beneath the blocks would freeze and expand, causing the blocks to lift. In addition, some blocks absorbed water and they swelled. After several days of this type of weather, some of the blocks would be lifted high enough to interfere with the operation of the streetcars. Since most of the lifted blocks were swollen, it was extremely difficult to push them back into place. The City Commissioners decided, therefore, that when blocks interfered with streetcar operation, they were to be removed and the resulting spaces filled with gravel. (Edmonton Evening Journal, 1909, March 15, p. 1) In the same press report (p. 1) it was stated that the City Commissioners were attempting to reach an agreement with the contractor for repairs to the pavement. No repairs were made, however, and most of the wood-block paving had been removed from Jasper and Namayo Avenues (97th Street) by the end of 1909. (CEAR, 1909, p. 97) A more permanent form of paving was necessary.

By May 1910, the snow from the previous winter was gone and track construction could be resumed. The City Commissioners had considered the problem of selecting a replacement paving and by

June 11 had settled on a type of paving that they felt would be satisfactory. The paving consisted of wire reinforced concrete with expansion joints, finished with "Bitulithic topping". (CECR No. 88, June 11, 1910) The "Bitulithic topping" referred to an asphaltic composition consisting primarily of bitumen. The actual construction started with crews first removing the gravel and any remaining wood-blocks from between the rails. Number 10 gauge expanded metal mesh was placed between the rails and a layer of concrete was then deposited on top to a height of approximately 4 inches (102 mm). In addition, the top surface of the concrete was shaped so that flangeways were formed at each rail-head with a 2 inch (51 mm) deep trough approximately 3 feet 8½ inches (1 130 mm) wide in the middle. When the concrete had hardened sufficiently, bitulithic compound was placed in the trough. The bitulithic surface, although even with the sides of the trough, was intended to have a ½ inch (13 mm) high crown between the rails so that the surface sloped towards the flangeways, thereby facilitating drainage. This new pavement replaced all wood-block pavement on ERR lines. The appearance of the new pavement may be observed in Figure 10 which is a cross-sectional drawing done for the ERR in 1910. (After City Engineers' Revised Plan, Section of Bitulithic Paving Between Tracks, August 29, 1910) Minor deletions plus the metric conversion were done by the author.

The installation of the new pavement on Jasper and Namayo Avenues (97th Street) and First (101st) Street took place throughout August and September. Crews worked on one track at a time in order to prevent the total disruption of streetcar service. (CEAR, 1910, p. 110)

Permanent Construction, 1910

The method of construction that was used in 1909 was abandoned

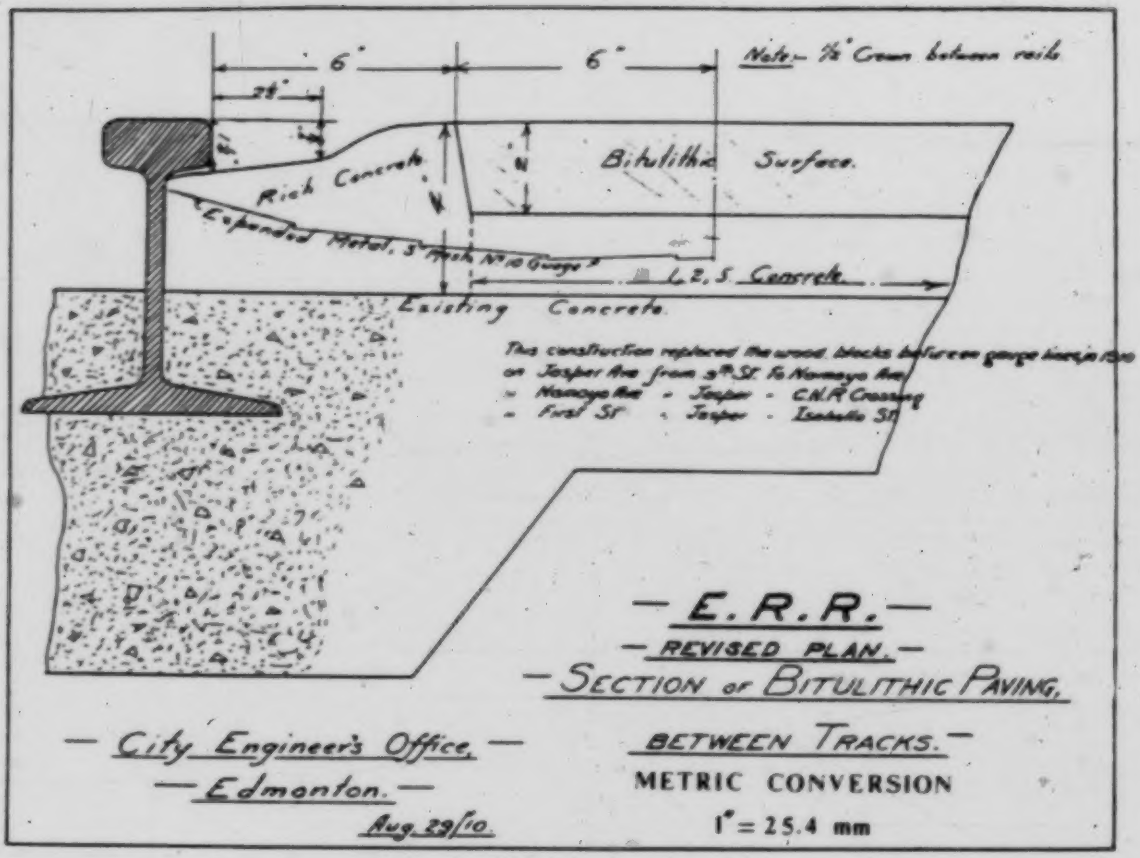

6"
6"
2½"
Note:– ½" Crown between rails
Bitulithic Surface.
Rich Concrete
Expanded Metal, 3" Mesh No 10 Gauge
1, 2, 5 Concrete
Existing Concrete.
This construction replaced the wood blocks between gauge lines in 1910
on Jasper Ave from 9th St. to Namayo Ave
" Namayo Ave - Jasper - C.N.R Crossing
" First St - Jasper - Isabella St
— E. R. R. —
— REVISED PLAN. —
— SECTION OF BITULITHIC PAVING,
BETWEEN TRACKS. —
— City Engineer's Office, —
— Edmonton. —
Aug. 29/10.
METRIC CONVERSION
1" = 25.4 mm

FIGURE 10.

in 1910 in favour of a different type of construction. The method of track support was the major difference between the two construction types. In the 1909 construction, a 4 inch (102 mm) thick concrete base laid on the bottom of the trench supported the tracks. In the 1910 construction, longitudinal "beams" of concrete, formed and set into the bottom of the trench and designed to lie directly under each running rail, were thought to provide better support than a uniformly thick concrete base. (CEAR, 1910, p. 90) After the trench had been excavated and after the concrete beams had hardened, wooden ties of the same dimensions and materials as those used in 1909 were placed across the beams at 2 foot (610 mm) intervals. Lengths of 80 pound per yard

(33.2 kg/m) ASCE T-rail were spiked directly to the ties. Concrete was then poured between the rails until there was an even layer covering the ties. The pavement used was one of two types. The first and most common type used consisted of concrete poured between the rails until even with the tops of the rails. Flangeways were formed in the concrete before it hardened. (CEAR, p. 90) The second type used consisted of granite paving blocks placed between the rails and in two rows along the outside edges of the tracks. Granite block paving was used on Namayo Avenue (97th Street) between the railroad crossing and Norwood Boulevard (111th Avenue). (CEAR, 1911, p. 63) A cross-section of this type of construction would resemble a cross-section of the 1907-1908 permanent construction, see Figure 3. It should be noted, however, that the spike blocks and steel ties were not used in the 1910 construction.

It has been mentioned earlier in this section that some City employees felt that the 1910 method of track construction was superior to the methods used previously. This notion was, however, the opinion of some City Engineers and the new superintendent of the ERR, C. V. Biswanger. Biswanger, who replaced C. E. Taylor in 1910, was forced to contend with rising construction and maintenance costs. While the 1910 construction was thought to have been as satisfactory as earlier construction methods, the 1910 track was less expensive to construct, since fewer materials were required. (CEAR, 1909, p. 99; 1910, pp. 68 & 84)

Only .77 of a mile (1.24 km) of permanent double-track was constructed in 1910. Map 4 (after Official Map of the City of Edmonton, 1938, and (CEAR, 1909, p. 90) shows the location of where the track was constructed. The one block section of isolated double-track on Main (104th) Street in Strathcona should be noted. This section of permanent track was constructed in conjunction with the City of Strathcona, whose crews were paving that portion of Main (104th) Street. A double-track line on Main Street was planned for future construction and both the Strathcona City Council and the City Commissioners of Edmonton felt that it would be mutually advantageous to lay that section of permanent track while the street was being paved. (CECR No. 134, August 1910) The Main Street trackage was not connected to the line on Whyte (82nd) Avenue because special work was required. Since the pavement on Whyte Avenue had to be torn up in order to install the special work, it was decided, by the Edmonton City Commissioners, not to install the special work until the line on Main Street was to be operated. (CECR No. 134, August 1910)

Temporary Construction, 1910

Until 1910, the methods used in the construction of temporary track had not been altered significantly. In the 1909 Annual Report, Superintendent Taylor noted that the Street Railway Department was having to spend inordinate sums of money to maintain the temporary track previously laid. The high maintenance was the result of a basic flaw in the track construction. Although the track was ballasted, there was no provision made for roadbed drainage. In addition, the surrounding road was usually not gravelled. During heavy rains, or during spring thaws, the movement of the water across the unpaved roads would remove some of the ballast. Water would also remain and would accumulate below the ballast. This would soften the road, which would further undermine the track. The result of the undermining was an undulating and dangerous track that required immediate repair. (CEAR, 1909, p. 97) It had been determined by the ERR superintendent and by the

City Engineers that some provision for adequate drainage was necessary if maintenance of temporary track was to diminish. In 1910, consequently, a major change in construction was made. Once the road surface had been graded, a shallow trench was dug longitudinally along the road. The trench was placed so that when the track was laid, the trench would be located directly beneath the centre of the track. After the trench was dug, it was filled to the top with gravel or stone rubble. In addition, smaller cross-trenches or culverts were installed "where convenient" between the main trench and drainage ditches or storm sewers. (CEAR, 1910, p. 90) Upon completion of the drainage system, the track was laid using the same type of methods and materials used in previous years. The ballast that was used, however, consisted of coal cinders or gravel. Coal cinders were used because of a difficulty in obtaining suitable gravel. (CEAR, p. 100)

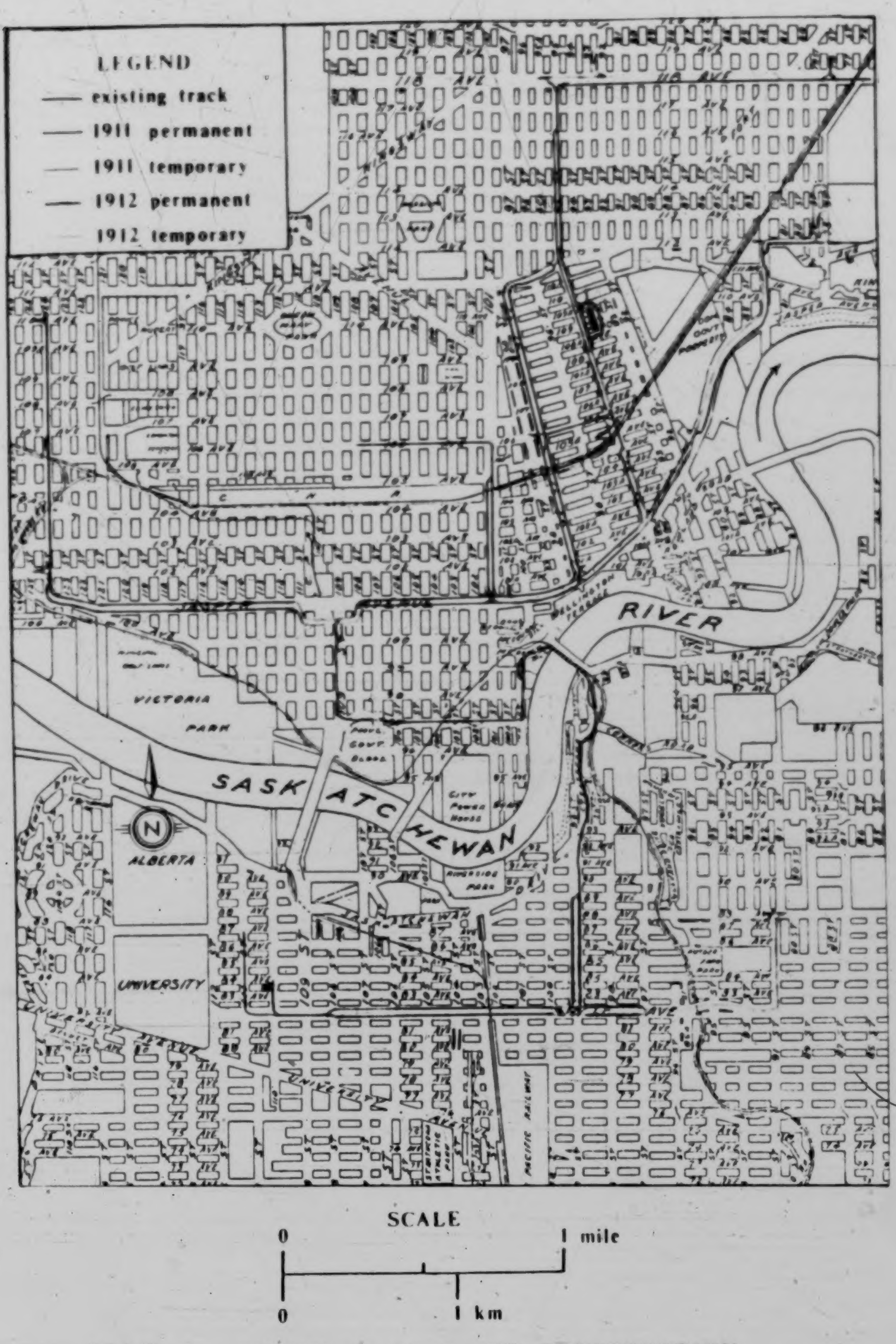
Although a total of 2.57 miles (4.14 km) of temporary single-track grade was prepared in 1910, only 1.48 miles (2.38 km) of track was laid and completed during that year. Delays in the arrival of materials was given as the reason for the small distance of track completed. All temporary track was constructed by City crews. (CEAR, p. 90 & p. 97) Maps 4 and 5 (both after Official Map of the City of Edmonton, 1938, and CEAR, 1910, p. 97) show the location and extent of both complete and incomplete single temporary track constructed in 1910.

Permanent Construction, 1911

In the 1910 Annual Report, Superintendent Biswanger urged the City Council not to consider any significant extensions of permanent track in 1911. Biswanger's reason for this was an attempt to keep the ERR's deficit from rising substantially. (P. 111) Biswanger was replaced by R. Knight in January 1911. (Edmonton Bulletin, 1911, January 30, p. 1) Knight shared Biswanger's concern over the deficit. Only .24 of a mile (0.39 km) of permanent double-track was constructed. (CEAR, 1911, p. 60) The construction replaced temporary track; no new extensions were built. (CEAR, p. 63) The distance constructed was the shortest length of permanent track constructed in any year since the start of construction in 1907. City crews as well as contractors constructed the permanent double-track, which was located on Whyte (82nd) Avenue between 2nd Street West and 4th Street West (106th Street and 108th Street) in Strathcona. (CEAR, p. 63) Map 6 (after Official Map of the City of Edmonton, 1938, and CEAR, 1911, p. 63) shows the location of permanent double-track constructed during 1911.

Temporary Construction, 1911

It was mentioned in the last section that in 1910, Superintendent Biswanger recommended that extensions of the ERR be kept to a minimum in order to reduce the growth of its deficit. Biswanger did recommend, however, that some temporary track be constructed. Most of the temporary construction was intended to provide a second track for some roads where only a single track had existed. (CEAR, 1910, pp. 111-112) In addition, the ERR ordered several single-end streetcars (streetcars that could be operated from one end only) in 1910. (CEAR, p. 8) In order to operate the single-end streetcars correctly, loops or Y's (wyes) had to be constructed at the termini of lines, or wherever it was deemed necessary for a streetcar to return along its route. To accommodate the single-end streetcars, therefore, Superintendent Biswanger recommended that six wyes be constructed at various points along the system. (CEAR, p. 112)


LEGEND
existing track
1911 permanent
1911 temporary
1912 permanent
1912 temporary
118 AVE
C N R
RIVER
VICTORIA PARK
PROVL. GOVT. BLDGS.
CITY POWER HOUSE
SASKATCHEWAN
RIVERSIDE PARK
N
ALBERTA
UNIVERSITY
WELLINGTON TERRACE
PACIFIC RAILWAY
SCALE
0
1 mile
0
1 km

MAP 6. EXTENT & TYPE OF CONSTRUCTION
1911 - 1912

City crews first completed the track that was begun in 1910. Work was then started on new sections. A total of 1.8 miles (2.9 km) of new track was constructed in 1911, all of it laid along streets that had a single temporary track. (CEAR, 1911, p. 63) In addition, several wyes were constructed, including one at the Strathcona car barns, to enable the single-end streetcars to be operated properly. (Letter from Secretary-Treasurer, City of Strathcona, to City of Edmonton Commissioners, April 26, 1911)

In the fall of 1911, the Cities of Strathcona and Edmonton agreed to amalgamate. By December, the Provincial Legislature gave its approval to the Edmonton-Strathcona Amalgamation Act. (Statutes of Alberta, 1911-1912, Chapter 66, pp. 524-531) While the Act stated that Strathcona would lose its name, the Act also stipulated that all present streetcar lines in Strathcona would be retained. In addition, the Act described certain extensions of existing streetcar lines that had to be constructed and completed in Strathcona by either December 31, 1912 or by February 1, 1914. (Statutes of Alberta, 1911-1912, Chapter 66, pp. 524-531) One of the extensions described was a line that was to be built from somewhere along Whyte (82nd) Avenue north to the University of Alberta. The location and routing of the extension was to be determined by the University Board of Governors and by the Strathcona City Council. (Statutes of Alberta, 1911-1912, Chapter 66, p. 529) It was ultimately decided to extend the existing single-track line on Whyte (82nd) Avenue one block west to Seventh (111th) Street, then north along Seventh Street to Fifth (87th) Avenue. The total length of the extension was .47 of a mile (0.77 km). (CEAR, 1911, p. 63, and Mundy's Street Index Map to Edmonton, 1912) The location of all temporary track, wyes and sidings (sometimes referred to as turnouts) constructed in 1911 may be seen on Map 6. (After Official Map of the City of Edmonton, 1938, CEAR, 1910, p. 112; 1911, p. 63, and ERR plans showing rail and rail returns, 1912)

Permanent Construction, 1912

In the 1911 Annual Report, Superintendent Knight stated,

> The maintenance of the ballasted [temporary] track has been an exceptionally heavy item in this year's operation, . . . future extensions should be largely constructed on a finished and permanent basis. The comparative lives of ballasted and paved track have been given as five and twenty years respectively, thereby necessitating the rebuilding of the ballasted track three times during the latter period. (p. 150)

Knight also cited maintenance costs of both track and rolling stock as further reasons to construct permanent track rather than temporary track. As was the practice in 1911, permanent track was constructed on streets where single or double temporary tracks had been laid previously. The concrete girder or concrete beam design of construction that was introduced in 1910 was used through 1912. (CEAR, 1913, p. 132) In addition, several pieces of special work were ordered during 1912 for delivery and installation in 1913. It should be noted that no permanent special work had been installed since 1908. (CEAR, p. 286) The largest and most unusual piece of special work ordered was a double-track "grand union" that was to be installed in the intersection of Jasper Avenue and Ninth (109th) Street. (Hadfields Steel Foundry blueprint showing layout and construction procedure of special work at Jasper Avenue and Ninth Street, 1912) A detailed description of this item may be found in a subsequent section that deals with permanent construction in 1913.

A total of 1.35 miles (2.17 km) of permanent double-track was constructed in 1912, all of it replacing temporary track. (SRDMR, January-December 1912) In addition, .48 of a mile (0.77 km) of single permanent track was constructed in the southern part of Edmonton (formerly Strathcona) along the west side of Fifth Street East (99th Street) from Whyte (82nd) Avenue to Seventh Avenue North (89th Avenue). (CEAR, 1912, p. 206) It should be noted that the construction of the single permanent track on Fifth Street East (99th Street) took place without the total disruption of streetcar service since the temporary track was located on the east side of the street. It should also be remembered that, in a previous section which described temporary construction in 1908, the ease of future construction was given as a possible reason for the placement of temporary track near a side of a road. It appears, therefore, that from the construction procedures of 1912, some temporary track was placed near the sides of certain roads in order to facilitate the construction of permanent track at some future time.

Map 6 (after Official Map of the City of Edmonton, 1938, and (CEAR, 1912, p. 206) shows the location of permanent track constructed during 1912.

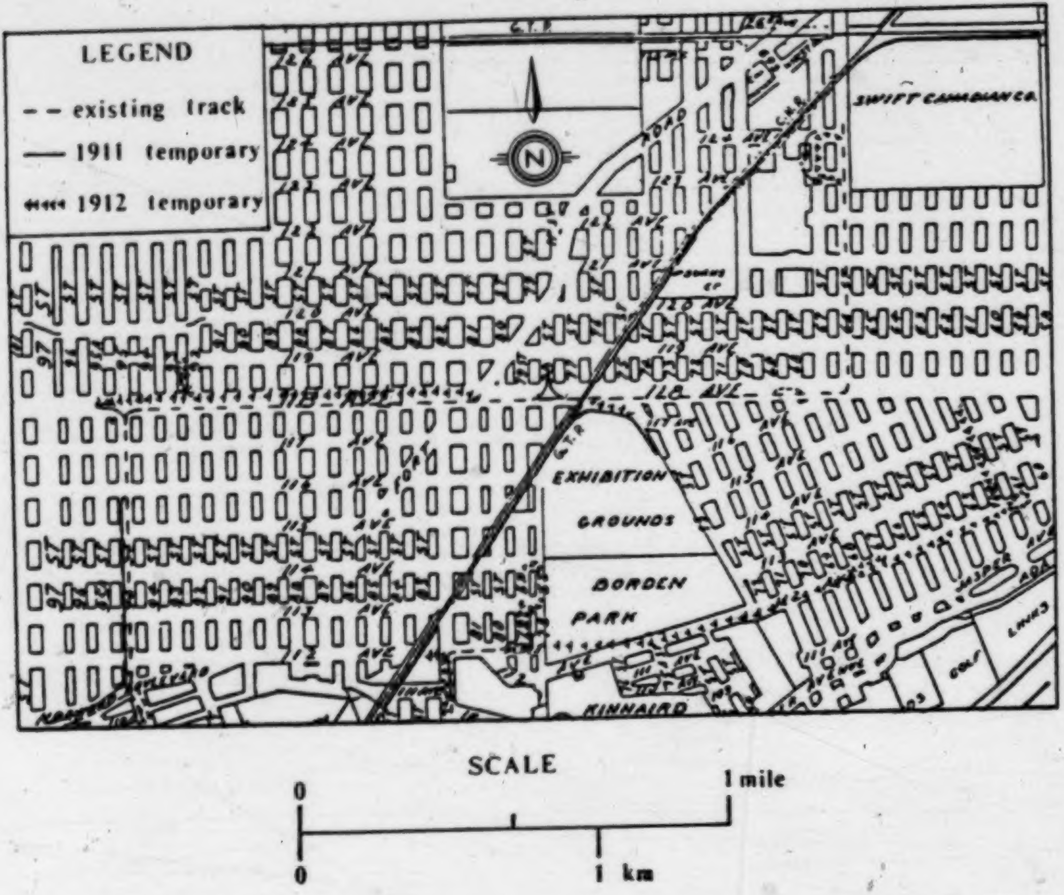
Temporary Construction, 1912

Most of the track constructed consisted of new extensions to the system. A single-track line was built along Whyte (82nd) Avenue from Seventh Street East (97th Street) to Eleventh Street East (91st Street), where it turned north onto Eleventh Street and terminated at Sixth Street North (88th Avenue). (CEAR, p. 206) This particular line was constructed to fulfill one of the requirements described in the Edmonton-Strathcona Amalgamation Act. (Statutes of Alberta, 1911-1912, Chapter 66, p. 529) An additional extension was built in Edmonton. Starting at the East End (Borden) Park, it travelled east through the park to Pine (112th) Avenue and continued east along Pine and Knox (112th) Avenues to

Campbell (61st) Street in the Highlands district, where it terminated. (CEAR, 1912, p. 206, and Mundy's Street Index Map of Edmonton, 1912) Although the ERR constructed the Highlands extension, the construction costs were underwritten by the Magrath-Holgate Company, a land development firm. The only exception to this was the portion of the line constructed in the East End (Borden) Park. (CEAR, 1912, p. 206) The remainder of the track constructed in 1912 consisted of turning loops, sidings and two sections of single-track which provided second tracks where they were laid. One track was constructed along Alberta (118th) Avenue between Kirkness and James (95th and 81st) Streets. The other track was built along Jasper Avenue, Kinnaird (82nd) Street and Pine (112th) Avenue, from the Penitentiary (Latta) Bridge to the East End (Borden) Park. (CEAR, p. 206)

In addition to the track already described, a temporary double-track diversion was constructed south of Jasper Avenue between Eighth and Eleventh (108th and 111th) Streets in early August. This diversion, which travelled along a lane between Jasper and Victoria (100th) Avenues, was intended to maintain streetcar service while crews removed the existing tracks on Jasper Avenue between Eighth and Eleventh Streets, and then prepared that section of Jasper Avenue for both a Canadian Pacific Railway (CPR) overpass and for the grand union that was mentioned in the previous section. (SRDGL, Account C4T, and Edmonton Capital, August 5, 1912)

Maps 6 and 7 (both after Official Map of the City of Edmonton 1938, CEAR, 1912, p. 206, and SRDGL, Accounts C4A-C4B) show the location and the extent of temporary track constructed in 1912.


LEGEND
- - existing track
—— 1911 temporary
‹‹‹‹ 1912 temporary
G.T.P.
C.N.R.
SWIFT CANADIAN CO.
N
ROAD
118 AVE
EXHIBITION
GROUNDS
BORDEN
PARK
KINNAIRD
GOLF
LINKS
SCALE
0
1 mile
0
1 km

MAP 7. NORTHEAST CONSTRUCTION, 1911–1912

Freight Track, 1912

It appears that several businesses in Edmonton became interested in being served by the ERR. Apart from being able to construct tracks to the premises of individual businesses, the ERR was also able to transport various pieces of freight and equipment from the steam railroads to the various city businesses. The ERR had two interchanges with steam railroads in 1912. One was with the Grand Trunk Pacific Railway (GTP), at their spur adjacent to Alberta (118th) Avenue. To connect the two railways, the ERR built a small spur between Phillips and Robertson (76th and 74th) Streets which travelled south from Alberta (118th) Avenue and connected with the GTP spur. (ERR Drawing showing Plan of Spur

Connecting E.R.Ry. Alberta Ave. & G.T.P.Ry. Exhibition Spur, 1912) The other interchange was with the Canadian Northern Railway (CNOR). The location of this interchange was in the northern part of the City yard, which was located between Kinistino and Syndicate Avenues (96th and 97th Streets), immediately south of Griesbach Street (105A Avenue). (Mundy's Street Index Map to Edmonton, 1912, and CEAR, 1912, p. 207) The ERR constructed a spur into the north yard from Syndicate Avenue (95th Street), between June and July 1912. (SRDGL, Account C4P) A total of three freight spurs were constructed in 1912 to various businesses in Edmonton. The businesses were: Rendall, MacKay and Michie, sash and door manufacturers, located on the south side of Wilson Street (110th Avenue) between Syndicate and Ottawa Avenues (95th and 93rd Streets); C. F. Taylor lumber yard, located on the north side of Alberta (118th) Avenue between Lorne and Kennedy (92nd and 93rd) Streets; Alsip Brick and Supply Company, located at the intersection of Pine (112th) Avenue and Kinnaird (82nd) Street. (SRDGL, Accounts C4M-C4Q, and Henderson's Edmonton City Directory, 1914) Plate 7 (Glenbow Archives) shows the appearance of the C. F. Taylor spur sometime during 1912 or 1913. The presence of railroad boxcars on the spur as well as the temporary track construction should be noted. The other piece of rolling stock on the spur was the ERR's motorized work/flat car. It will be discussed in a subsequent chapter.

In addition to the three freight spurs constructed, a special spur was built along Grace (62nd) Street from the Highlands passenger line on Knox (112th) Avenue, to a point immediately south of Alberta (118th) Avenue. The spur, which was 1,000 feet (304.8 m) long, was constructed for the sole purpose of transporting materials and supplies for the construction of the Edmonton Public School Board's new Highlands School, located

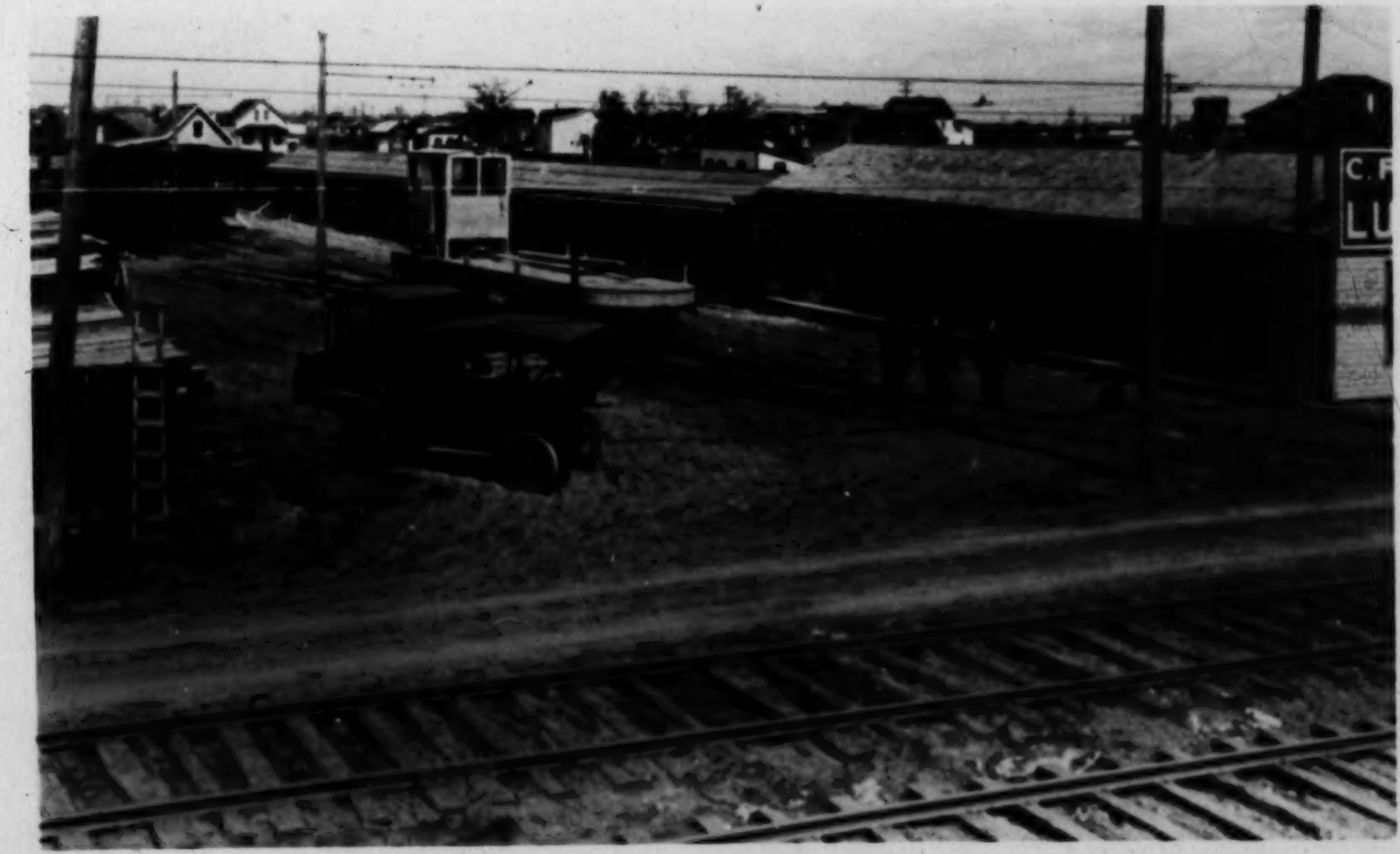


Plate 7. (Glenbow Archives) Taylor Spur and Work Car Number 4

on the west side of Grace (62nd) Street, south of Alberta (118th) Avenue. (Edmonton Journal, November 14, 1917, p. 2, and Henderson's Edmonton City Directory, 1913) The construction of this spur emphasized the fact that the ERR had a vital part in the movement of freight within the City before the development of high capacity road vehicles. The spur was not used after the completion of the Highlands School. (Edmonton Journal, November 14, 1917, p. 2)

The location of all spurs constructed during 1912 may be seen on Maps 6 and 7.

Block Signals, 1912-1913

By 1912, most of the heavily used lines were double-tracked. A notable exception was the long single-track section that began at Ninth (109th) Street and Victoria (100th) Avenue, and ended at Fifth Street East (99th Street) and Seventh Avenue North (89th Avenue). (See Map 6) Although several passing sidings had been constructed, streetcar operation along this particular section was more difficult than along other sections of single-track. This single-track section, unlike most other single-track sections on the ERR, was very long and encountered several sharp curves and steep grades. The grades and curves effectively obscured portions of the track located between passing sidings. When a streetcar reached a siding or the end of the double-track, it usually had to wait for the streetcar travelling in the opposite direction to vacate that single-track section. Problems arose, however, if the streetcars happened to be delayed. If a streetcar arrived at a siding or at the end of the double-track far behind schedule, the motorman, upon observing a seemingly clear track, could assume that the streetcar travelling in the opposite direction had already been through that single-track section. If the motorman's assumption was wrong, the other streetcar being on an obscured portion of the track, the streetcars would meet somewhere along the single-track. One streetcar would have to back along the track until a siding or the double-track was reached. Conversely, a streetcar could wait at a siding or at the end of the double-track until the motorman saw the other streetcar pass. If, however, the other streetcar had been delayed for a long period of time, the waiting streetcar would fall behind schedule and would also delay other streetcars behind it. These problems were common along this section of track since the start of service in 1908. (Edmonton Bulletin, December 28, 1911, p. 8)

There were many suggestions from the general public on how to eliminate the problem. The suggestions ranged from installing telephones or signals at either end of the single-track sections to installing more sidings. (Edmonton Bulletin, May 31, 1912, p. 2) No action took place, however, until the new Superintendent, W. T. Woodroofe, took charge of the system in July 1912. (Edmonton Journal, July 4, 1912) After travelling the ERR, Woodroofe decided that a signal system was required if the safety and speed on the long single-track linking the northern and southern parts of Edmonton was to improve. (Edmonton Capital, September 7, 1912)

In the operation of single-track steam railroads, the track was divided into operational sections called "blocks". Each block was protected at either end by signals referred to as "block signals". (Harding & Ewing, 1926, p. 243) The signals usually showed the condition of the block, occupied or vacant, by displaying colored lights and some other form of indicator. The signals could either be controlled manually or automatically.

The ERR divided the single-track section into three blocks and installed signals at both ends of each block. (Edmonton Bulletin, September 23, 1912, p. 2) One block started at the end of the double-track on Ninth (109th) Street at Victoria (100th) Avenue and ended at the siding on Saskatchewan (97th) Avenue. The next block was located between the Saskatchewan Avenue siding and the siding on Currie (100th) Street. The final block was located between the siding on Ross (Strathcona) Road and the start of the double-track on Fifth Street East (99th Street) at Seventh Avenue North (89th Avenue). (ERR Drawing of Rail Returns, June 1912) Plate 9 (Glenbow Archives) shows the signal that was installed at the southern end of the Ross Road block near Eighth Avenue North (90th Avenue). Harding & Ewing (1926) describe this type of signal and its operation. The signal employed three colored lights and three movable colored discs to indicate the status of the block. Each signal could display three indications: (1) neutral, if no streetcar was in the block, no lights or discs would be visible; (2) permissive, if an approaching streetcar entered the block, only if the signal indicated neutral, the signal would display two white lights and two white discs, indicating that it was safe to proceed and that the other signal indicated stop; (3) stop, a red light and a red disc were visible, indicating that a streetcar was already in the block and that the approaching streetcar would have to wait clear of the single-track until the signal displayed a neutral indication. (pp. 253-254) The signals were activated by an electrical contactor installed on the overhead (trolley) wire a few yard (metres) before each signal. As a streetcar approached one of the signals, its trolley wheel would touch the contactor. This action closed an electrical circuit to a relay which turned the signals on and which set the indications of each one. When the streetcar left the block, the trolley wheel would touch the other contactor. This action would cause the relay to open, shutting off the signals, thus presenting a neutral indication. The signals and contactors were interconnected by overhead wires that were strung on poles that were located along the side of the road. (Harding & Ewing, pp. 252-256) The overlay for Plate 9 indicates the contactor and the discs of the signal. It should be noted that the signal is displaying a permissive indication. The combination sweeper and baggage streetcar can, therefore, proceed through the block without meeting another streetcar travelling in the opposite direction.

The block signal system was short-lived. By the end of 1913, permanent double-track had been constructed from Victoria (100th) Avenue to a point on Currie (100th) Street near the northern end of the Low Level Bridge. In addition, permanent double-track was constructed along Fifth Street East (99th Street) to Ross (Strathcona) Road, and along Ross Road to Eleventh Avenue North (93rd Avenue). (CEAR, 1913, p. 286; see Map 8) The double-track construction eliminated two single-track blocks entirely and eliminated an obscured portion of the track in the Ross Road block. The block signal system had become superfluous. It was removed during 1913, stored and later disposed of as surplus material. (CECR No. 211, October 1, 1915)

Permanent Construction, 1913

It was mentioned previously, in the section describing 1912 permanent construction, that Superintendent Knight recommended that new extensions to the system be of permanent construction in order to reduce track and rolling stock maintenance costs. (CEAR, 1911, p. 150) Knight's recommendation was continued by his successor, W. T. Woodroofe, who stated in January 1913 that, "It is the intention this year to replace all temporary unballasted track with permanent track, thus cutting down this item almost entirely." (CEAR, 1912, p. 205 & p. 207) The replacement of temporary track by permanent construction had begun, to some extent, during 1912 with the construction of the Jasper Avenue diversion and with the ordering of the grand union for the intersection of Ninth (109th) Street and Jasper Avenue. In addition to these actions, the City Council had given its approval in December 1912 to a grandiose track construction plan formulated by an Inspector Moir of the ERR. Moir's plan, if completed, would have provided the ERR with a total of 150 miles (241.4 km) of permanent double-track; distance reckoned as single-track. (Canadian Railway and Marine World, January 1913, p. 39) While Moir's plan called for 18 single-track miles (29 km) of permanent double-track to be built in 1913, the actual distance of permanent track built in 1913 was 21.71 miles (34.9 km). This distance, which included both single and double construction, was calculated as single-track. (CEAR, 1913, pp. 285-286) It may be asked why there was such a large expansion of the ERR's permanent trackage in 1913 considering the economic constraints of previous years. In addition to Superintendent Knight's premise that permanent track would ultimately reduce maintenance costs, the population of Edmonton as well as ridership on the ERR had been increasing greatly. In the 1912 Annual Report, it was indicated that ERR ridership for that year was more than double the ridership of 1911. (P. 14) It was the general concensus of most City officials that the population would continue to increase at a rapid rate. In view of increasing population and ridership, it was thought that large extensions to the ERR were indispensable if the street railway was to serve Edmontonians adequately. (CEAR, pp. 1-14 & p. 208)

An entirely new method of permanent construction was adopted in 1913. It had been found that the concrete beam or concrete girder construction of 1910-1912, while relatively inexpensive to construct, was subject to rapid disintegration from the vibrations caused by passing streetcars. It was stated in an article written by H. C. Saunders, a Construction Engineer of the ERR that,

> It was found that the vibration of the rail directly against the concrete caused a gradual crumbling away of the top and sides of the [concrete] girder, so that the rails were ultimately balanced upon a knife edge of concrete. . . . cases were noted where the rail had settled 4in. and 5in. [102 mm and 127 mm] below the paving, necessitating constant repair and expensive shimming. In view of this experience the base type of construction was adopted. (Edmonton Official Gazette, July 2, 1914, p. 255)

The "base type" or "concrete slab construction", as it was usually referred to, supported the track by means of a 6 inch (152 mm) thick layer of concrete laid on a prepared subgrade. (CEAR, 1913, p. 132 & p. 286) The subgrade usually consisted of a trench excavated along the centre of the road. The trench was dug to a depth of approximately 10 inches (254 mm) below the graded surface of the road, the sides of the trench sloping 45° from top to bottom. The width of the trench for double-track, measured across the top of the trench, was either 22 feet 2 inches (6 756 mm), or 20 feet 6 inches (6 248 mm). The width used depended upon whether the centres of the two tracks were to be 12 feet (3 658 mm) apart, or 10 feet (3 048 mm) apart. The track centre distance was determined by the overall width of the road where the tracks were to be laid. If a single-track was to be constructed, the width of the trench, measured across the top, would be approximately 10 feet (3 048 mm). (CEED, Drawings S.R.13 #1 & S.R.13 #2, February 22, 1913) When the excavation of the trench was complete, the bottom was packed by a 10 ton (9 072 kg) steam roller. A 6 inch (152 mm) layer of concrete was then deposited along the bottom of the trench.

It should be noted that no metal reinforcing of any kind was used in that layer. (CEED, Drawings S.R.13 #1-S.R.13 #4, February 22, 1913) A sand cushion of approximately 1 inch to 2 inches (25.4 mm to 50.8 mm) was deposited on the concrete when it had hardened, but only where the ties would be placed. The purpose of the sand was to provide resilience to the track. In addition, the sand assisted with the alignment of the track since the ties tended to slide easily along the sand. Wooden ties of the same size and materials used previously were laid along the sand-covered concrete at intervals of 2 feet (610 mm), measured centre to centre. Lengths of 80 pound per yard (33.2 kg/m) ASCE T-rails were then placed directly on the ties. (CEAR, 1913, p. 286)

A dispute arose between Superintendent Woodroofe and the City Engineers. The Engineers, who collaborated with the ERR on track construction, wanted to use steel tie plates between the rails and the ties. A tie plate was a flat piece of steel that could be placed under the rails on each tie. The purpose of a tie plate was to distribute the weight of the rail over a large area of the tie, thereby increasing its life, since the likelihood of the rail cutting into the tie would be reduced. (Doane & Parkham, 1926, § 19, p. 9) The Engineers, therefore, ordered a large quantity of tie plates. Superintendent Woodroofe, however, believed that tie plates on a street railway were superfluous since the weight of the streetcars and rails were much less than the weights of the rail and equipment used on the main lines of most steam railroads where tie plates were most frequently used. Woodroofe prevailed and the tie plates were not used. (CECR No. 211, October 1, 1915) Woodroofe was later blamed for the premature failure of some 1913 permanent track in 1915 (CECR No. 248, November 29, 1915)

After being placed on the ties, the lengths of the rail were joined together by means of "continuous joints". (CEAR, 1913, p. 286) Until 1913, rails on the ERR had been joined by means of plain angle bars, also known as fishplates, channel plates or joint plates. Angle bars were cast or forged steel plates that were placed on both sides of the rail. Most angle bars fitted between the bottom of the rail head and the top of the rail foot. In addition, angle bars had holes drilled through them, usually four, to allow track bolts to pass through. In usual practice, one half of the angle bar was bolted to the end of one rail section, the other half being bolted to the adjoining rail. Angle bars were made in different sizes to accommodate the various heights of rail. (Doane & Parkham, 1926, § 19, p. 19) Some plain angle bars are visible in Plates 5 and 6. While the plain angle bar prevented the rail sections from separating, they did little to control vertical movement and bending of the rail at the joints. It should be remembered that in ERR construction, the joints themselves were placed between individual ties. See the section on 1908 temporary construction for further elaboration. A continuous angle bar consisted of a standard angle bar with an integral base which resisted vertical movement of the rail. Figure 11 (after drawing by the Rail Joint Company of Canada, showing a continuous rail joint, and Doane & Parkham, 1926, § 19, p. 19) shows a complete continuous rail joint as applied to ASCE-section T-rail.

When the rail sections had been joined, the rails were gauged, aligned and then spiked to the ties. Concrete was deposited between the rails until the tops of the ties were covered. Between the outside rails and the sides of the trench, concrete was poured until it was about level with the bottom of the railheads. (CEED, Drawing of Cross Section of Street Railway Shewing Method of Paving Between the Gauge, April 1913) Plate 8 (Glenbow Archives) illustrates the appearance of the

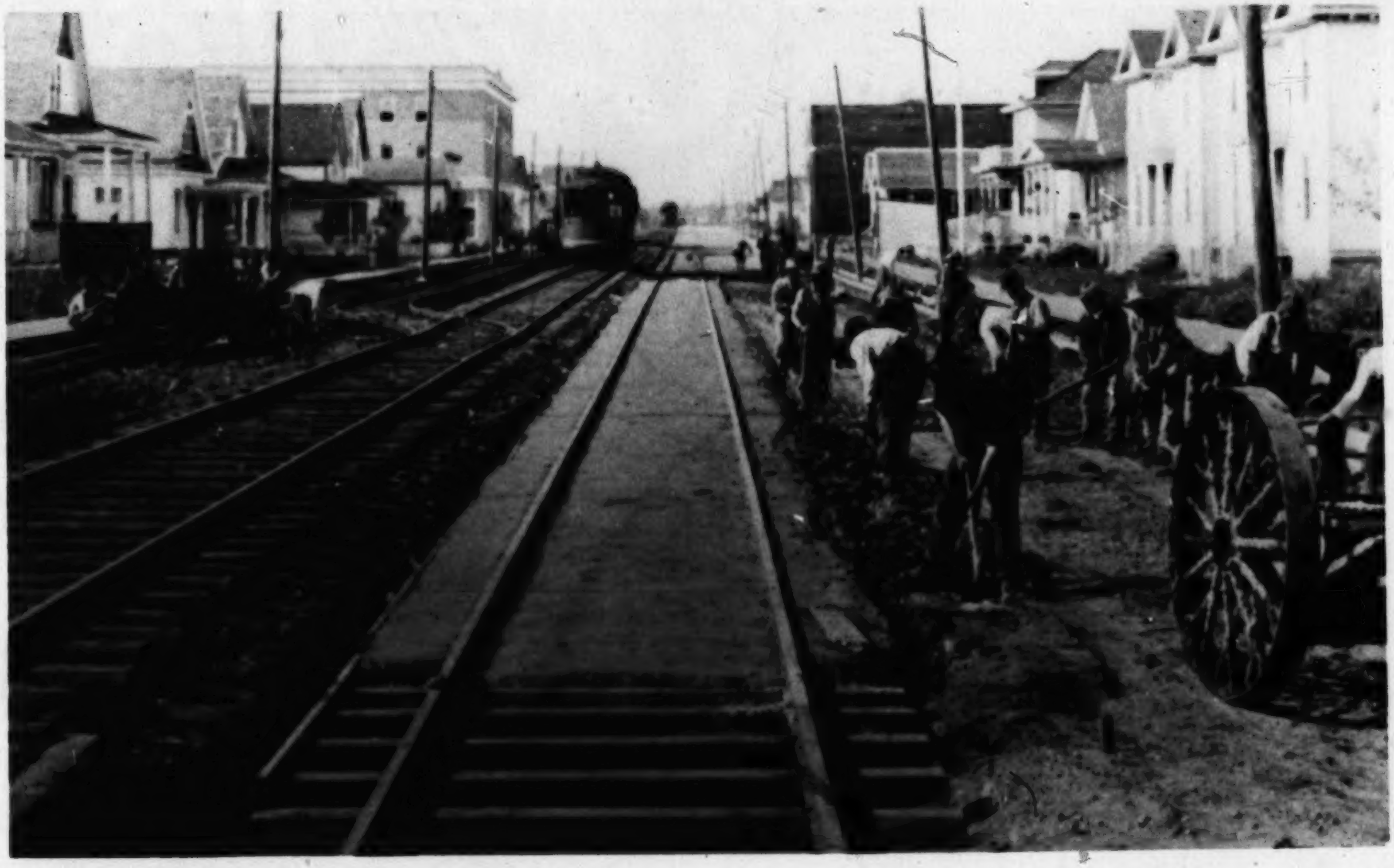


Plate 8. (Glenbow Archives) Constructing Permanent Track on Kirkness Street, 1913

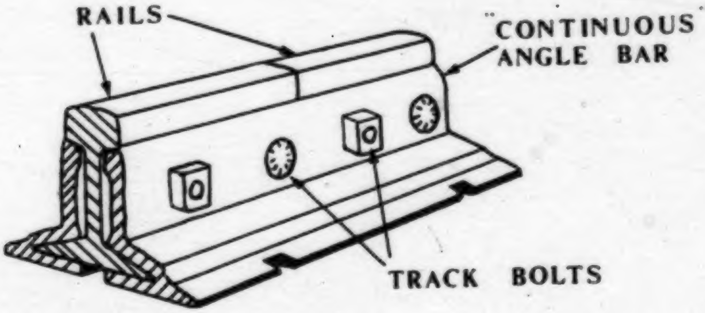


FIGURE 11. CONTINUOUS RAIL JOINT

construction to this point. The photographer was facing north on Kirkness (95th) Street between Oak (116th) and Beech (117th) Avenues. Only one permanent track is being constructed at a time in order to prevent total disruption of streetcar service. The track on the extreme left is a temporary siding (turnout). In constructing the pavement between the running rails, crews first laid down a layer of Number 10 gauge expanded metal mesh. Concrete was then deposited between the rails until level with the tops of the rail heads. Before the concrete hardened, flangeways were formed and the surface of the concrete was scored to resemble paving blocks. (CEAR, 1913, p. 132) Plate 9 (Glenbow Archives) shows the appearance of some 1913 concrete paving. The photograph was taken on Ross (Strathcona) Road immediately south of Eleventh Avenue North East (93rd Avenue). The photographer was facing south. The checked surface of the concrete should be noted. The temporary track on the left was the original interurban line between Edmonton and Strathcona constructed in 1908.

The distance of permanent track constructed in 1913 was more than double the distance of permanent track constructed between 1907

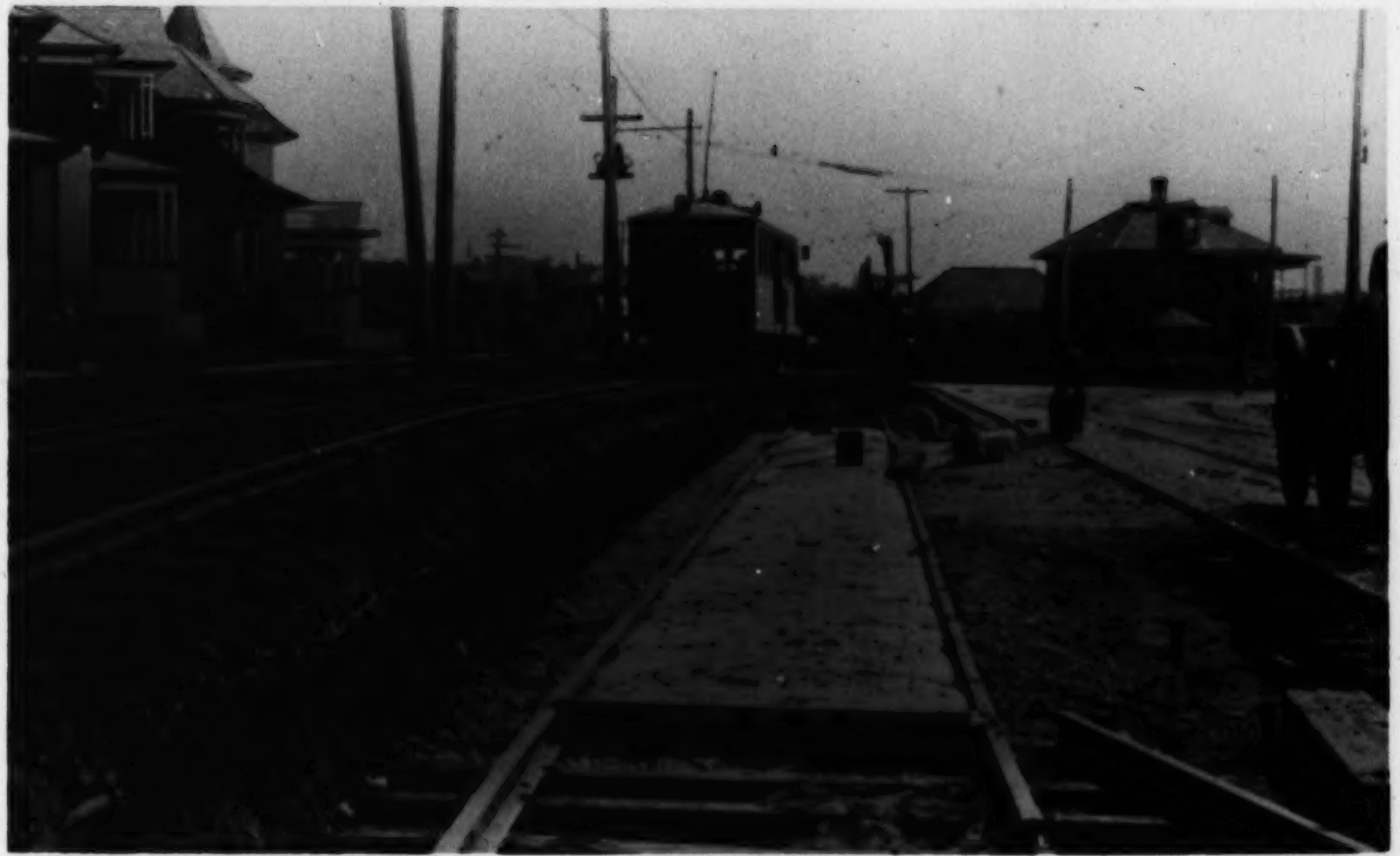
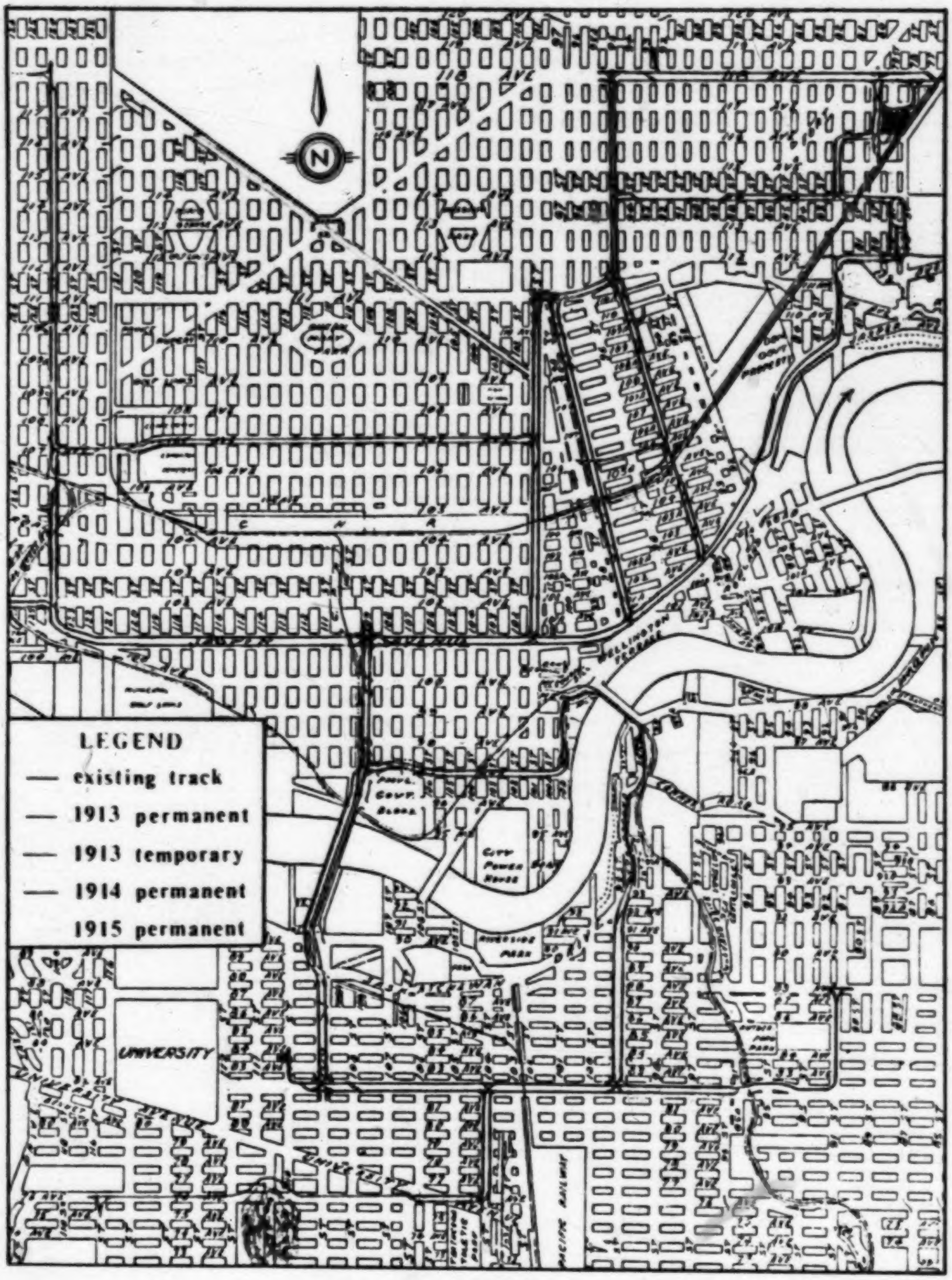


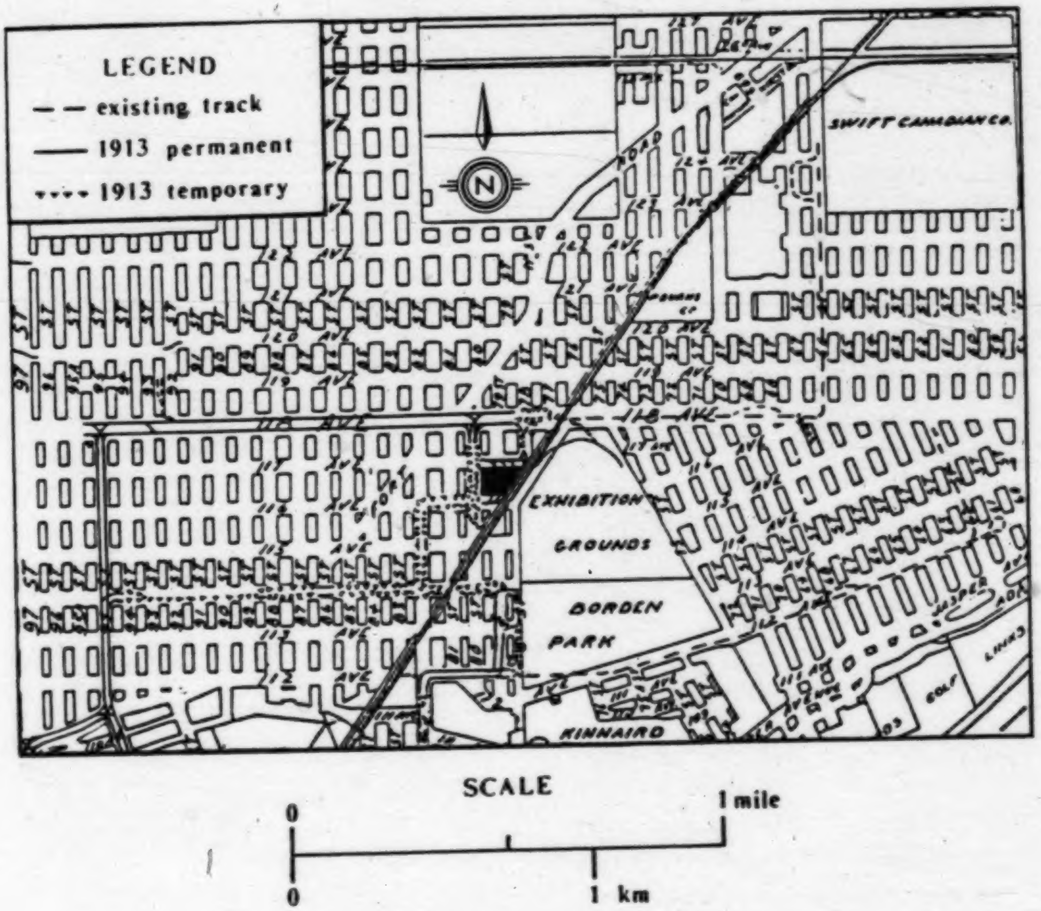
Plate 9. (Glenbow Archives) Signal and Construction on Ross Street, 1913

and 1912. A total of 21.714 miles (34.9 km) of permanent track, measured as single-track, was constructed during 1913. Of this distance, 1.495 miles (2.41 km) was permanent single-track. (CEAR, 1913, pp. 285-287) Maps 8 and 9 (both after Official Map of the City of Edmonton, 1938, and CEAR, 1913, pp. 285-287) show the location of the permanent track constructed in 1913. It should be noted that the double-track line built across the new High Level Bridge was not paved, nor were the immediate approaches. The tracks were laid on the top deck of the bridge on either side of the CPR track. No traffic besides streetcars and trains was allowed on the top deck. (ERR Drawing Showing Plan of Approaches to the High Level Bridge, 1913, and ERR Sketch Showing Cross-Section of Top Deck of High Level Bridge, 1913) Special large ties were used to support the rail. They were 10 feet (3 048 mm) long, 9 inches (22.9 mm) thick and 6 inches (152 mm) wide. (ERR Sketch Showing Cross-Section of Top Deck of High Level Bridge, 1913) The ties were placed directly on the bridge. A wooden stringer was placed near each end of the ties. These 6 inch square (152 mm X 152 mm) stringers, which ran perpendicular to the ties, were bolted to every third tie and were intended to prevent shifting of the ties. (ERR Sketch Showing Cross-Section of Top Deck of High Level Bridge, 1913, and Provincial Archives of Alberta photograph A.4708) Every third tie not bolted to the stringers was bolted to the steel work of the bridge. (Provincial Archives of Alberta photograph A.4708) Running rails were then laid on top of the ties. The rails, 80 pound per yard (33.2 kg/m) ASCE T-rails, were first centred on the ties. The rails were then aligned to the proper gauge and then spiked to the ties. It appears that continuous rail joints were not used. (Provincial Archives of Alberta photograph A.4708)

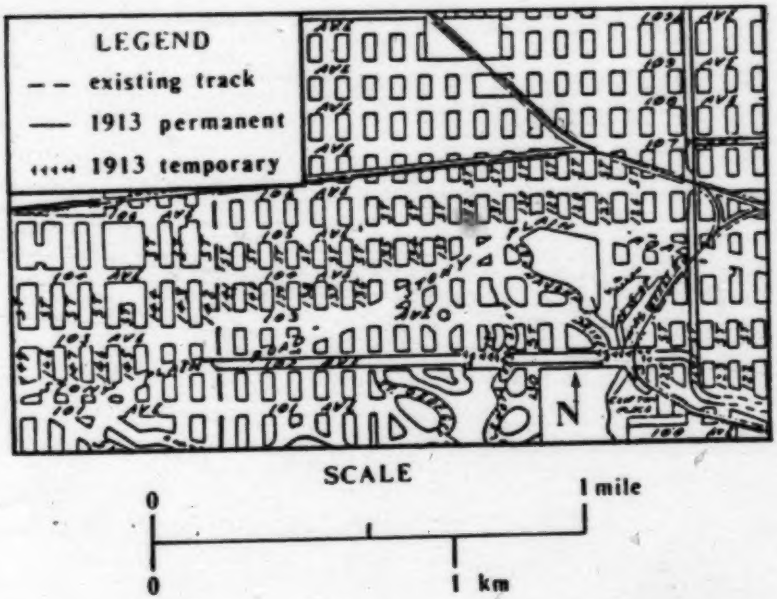
A second set of rails was laid between the running rails. This


LEGEND
existing track
1913 permanent
1913 temporary
1914 permanent
1915 permanent
N
C N R
WELLINGTON TERRACE
PROVL. GOVT. BLDGS.
CITY POWER HOUSE
RIVERSIDE PARK
UNIVERSITY
PACIFIC RAILWAY
SCALE
0
1 mile
0
1 km

MAP 8. EXTENT & TYPE OF CONSTRUCTION
1913 – 1915


LEGEND
existing track
1913 permanent
1913 temporary
N
SWIFT CANADIAN CO.
118 AVE
EXHIBITION
GROUNDS
BORDEN
PARK
KINNAIRD
GOLF
LINKS
JASPER
SCALE
0
1 mile
0
1 km

MAP 9. NORTHEAST CONSTRUCTION, 1913


LEGEND
existing track
1913 permanent
1913 temporary
N
SCALE
0
1 mile
0
1 km

MAP 10. WESTERN CONSTRUCTION, 1913

second set was usually laid with old 60 pound per yard (24.9 kg/m) rail and was intended to act as a guard, preventing a streetcar from rolling off the bridge should it derail while crossing. (ERR Sketch Showing Cross-Section of Top Deck of High Level Bridge, 1913) The approaches to the bridge were initially built so that streetcars travelled across in the same manner in which they travelled along the street; the left hand track for south-bound streetcars, the right hand for north-bound. (ERR Drawing Showing Plan of Approaches to the High Level Bridge, 1913) This arrangement was unsatisfactory for single-end cars. These had doors only on the right side. If there was a derailment or similar emergency, the passengers could not leave by the doors because the steps would extend over the river below.

The year 1913 marked the first time since 1908 that permanent special work was installed in Edmonton. (CEAR, p. 286) In the section describing permanent construction in 1912, it was mentioned that several pieces of special work were ordered for 1913 delivery, the largest being a double-track grand union. A "grand union" may be defined as a unit of special work which enabled a streetcar, entering an intersection from any one of the four directions, to proceed either through the intersection or to make a right hand or a left hand turn. Figure 12 (after Hadfields Steel Foundry blueprint showing layout and construction of special work at Jasper Avenue and Ninth Street, 1912) shows the appearance, in plan view, of the grand union at Ninth (109th) Street and Jasper Avenue.

The grand union was manufactured in Sheffield, England by Hadfields Steel Foundry and was shipped to Edmonton in pieces. The rails used in the construction were D.K. 96c. (Hadfields Steel Foundry blueprint of special work at Jasper Avenue and Ninth Street, 1912) In addition to the grand union, twenty-eight other pieces of special work were

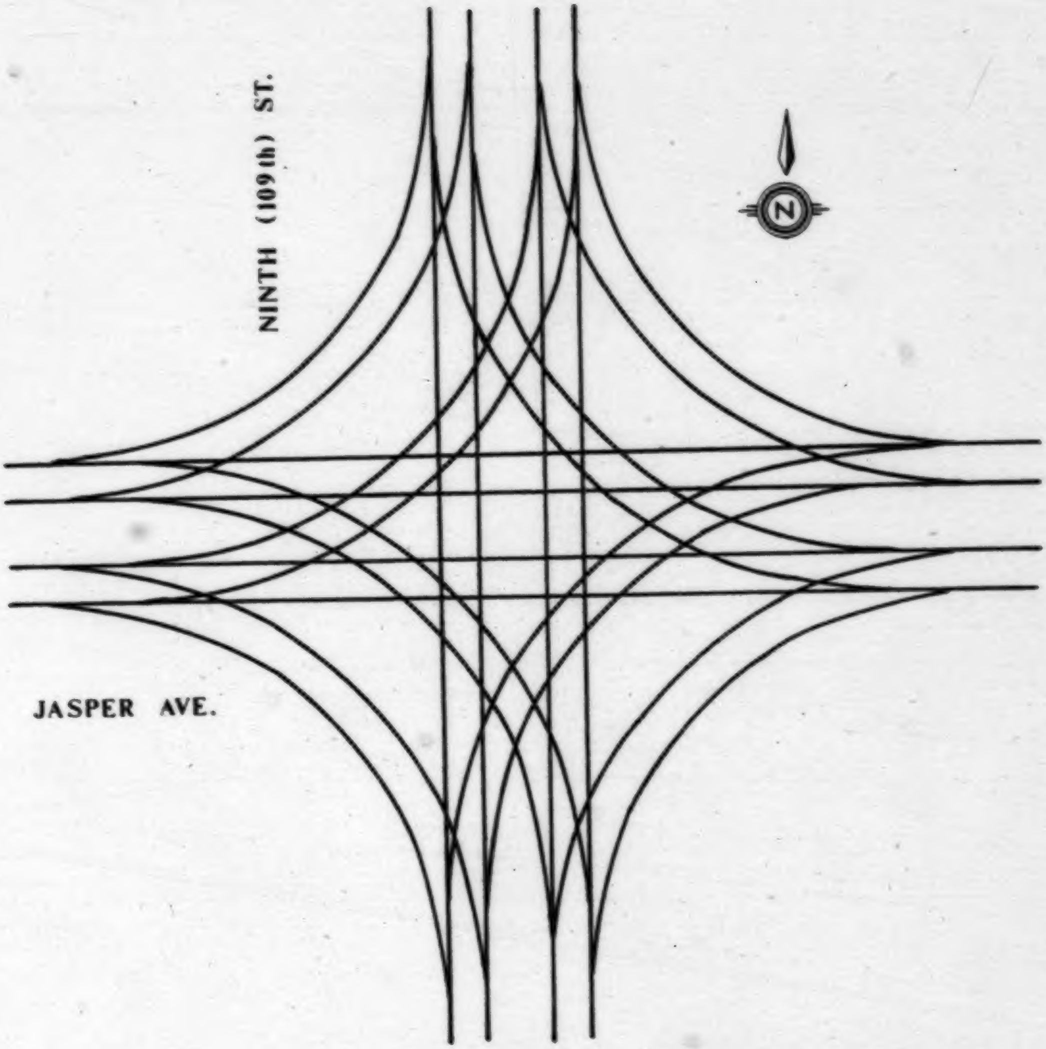

NINTH (109th) ST.
N
JASPER AVE.

FIGURE 12. PLAN OF GRAND UNION

installed during 1913. (CEAR, 1913, pp. 286-287) Apart from the grand union and one double-track right hand branch-off, which were manufactured by Hadfields Steel Foundry, all other 1913 special work was manufactured by the Lorain Steel Company of Johnstown, Pennsylvania. (Lorain Steel Company blueprints) Table 1 (after CEAR, 1913, pp. 286-287) describes the location and type of each piece of permanent special work installed in 1913. The rail used in the Lorain special work was type 108-398 grooved girder guard rail. (Lorain Steel Company blueprints) The use of grooved girder guard rails explains why the ERR ordered prepared curves for several locations. It was mentioned previously that most street railways did not have the equipment to bend grooved girder guard rail properly. Most of the special work types mentioned in Table 1 have been described in previous sections. There are, however, two types of special work that require elaboration; the three-part through Y and the "car barn special".

A three-part through Y consisted basically of a standard three-part Y combined with a crossing so that a streetcar could proceed through the three-part through Y from any one of four directions without having to make a right hand or left hand turn. Figure 13 (after Lorain Steel Company blueprint of the three-part through Y at 5th Street West and Whyte Avenue, 1913) shows the plan view of the three-part through Y installed at the intersection of 109th Street and 82nd Avenue. Although Table 1 lists two three-part through Y's, they were never fully used since the lack of connecting tracks enabled them to be used only as standard three-part Y's. (ERR Drawing of track system, April 1920) The other term in need of elaboration is the "car barn special". The ERR constructed a new north-side car barn on Beech (117th) Avenue in 1913. In order for streetcars to enter the various car barn tracks

Table 1 **Double-Track and Single-Track Special Work Installed in 1913**

Double-track Special Work

Type	Location
Grand Union	Jasper Avenue and 9th (109th) Street
Three-part Y	Alberta (118th) Avenue and John (80th) Street
Three-part Y	Alberta (118th) Avenue and Kirkness (95th) Street
Three-part Y	Norwood Boulevard (111th Avenue) and Kirkness (95th) Street
Three-part Y	1st (101st) Street and Nelson (107th) Avenue
Three-part Y	Norwood Boulevard (111th Avenue) and Namayo Avenue (97th Street)
Three-part Y	24th (124th) Street and Short (107th) Avenue
Three-part Y	Saskatchewan (97th) Avenue and 9th (109th) Street
Three-part Y	5th Street East (99th Street) and Whyte (82nd) Avenue
Three-part Y	Main (104th) Street and Whyte (82nd) Avenue
Three-part Through Y	Norwood Boulevard (111th Avenue) and 1st (101st) Street
Three-part Through Y	5th Street West (109th Street) and Whyte (82nd) Avenue
Right Hand Branch-off	Kirkness (95th) Street and Spruce (114th) Avenue
Right Hand Branch-off	Main (104th) Street and 6th Avenue South (76th Avenue)

Left Hand Branch-off	Pine (112th) Avenue and Agnes (79th) Street
Left Hand Branch-off	Athabasca (102nd) Avenue and 24th (124th) Street
Curve	Kinnaird (82nd) Street and Pine (112th) Avenue
Curve	Jasper Avenue and 24th (124th) Street
Curve	Saskatchewan (97th) Avenue and Curry (100th) Street

Single-track Special Work

Type	Location
Car Barn Special	Beech (117th) Avenue and Douglas (78th) Street
Combination Y and Crossover	24th (124th) Street and Tretheway (105th) Avenue
Right Hand Crossover	Alberta (118th) Avenue and Kennedy (93rd) Street
Right Hand Crossover	1st (101st) Street and Vermilion (106th) Avenue
Right Hand Crossover	Syndicate Avenue (95th Street) and Edmiston Street (110A Avenue)
Right Hand Crossover	Jasper Avenue and 9th (109th Street
Right Hand Crossover	24th (124th) Street and Nipigon (112th) Avenue
Right Hand Crossover	Saskatchewan (97th) Avenue and 8th (108th) Street
Right Hand Crossover	5th Street East (99th Street) and 10th Avenue North (92nd Avenue)
Right Hand Crossover	Whyte (82nd) Avenue and 4th Street West (108th Avenue)

from the paved street, it was necessary to install a series of sharply-curved and closely-spaced right hand branch-offs. These branch-offs were made of grooved girder guard rails (Lorain 108-398) as well as some special rail profiles. The branch-offs were fabricated to conform to specifications provided by the ERR. A total of 5 left hand and 8 right hand branch-offs comprised the "car barn special". (Lorain Steel Company blueprints, 1913)

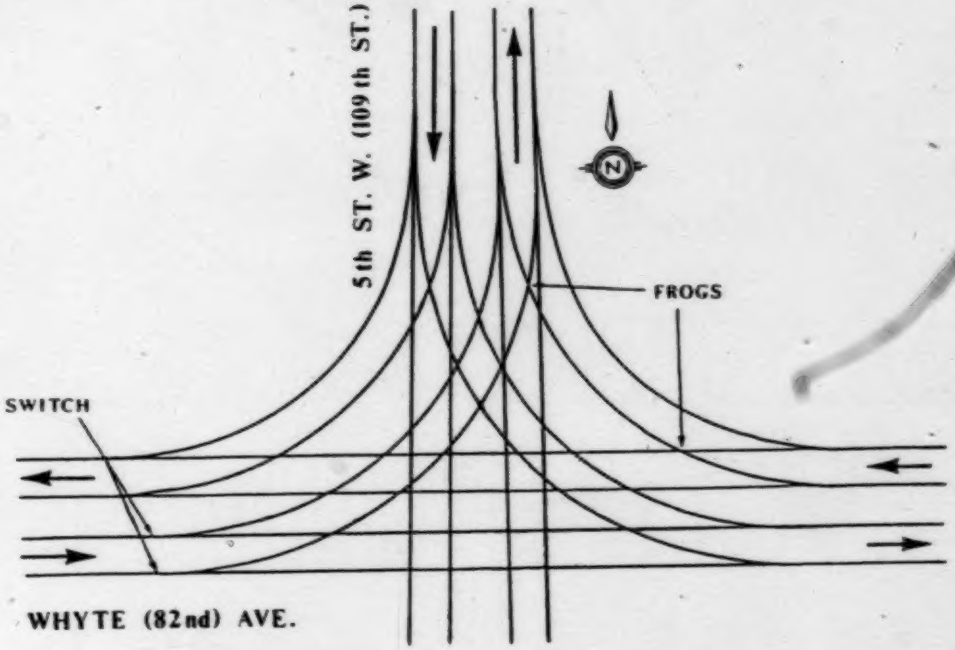
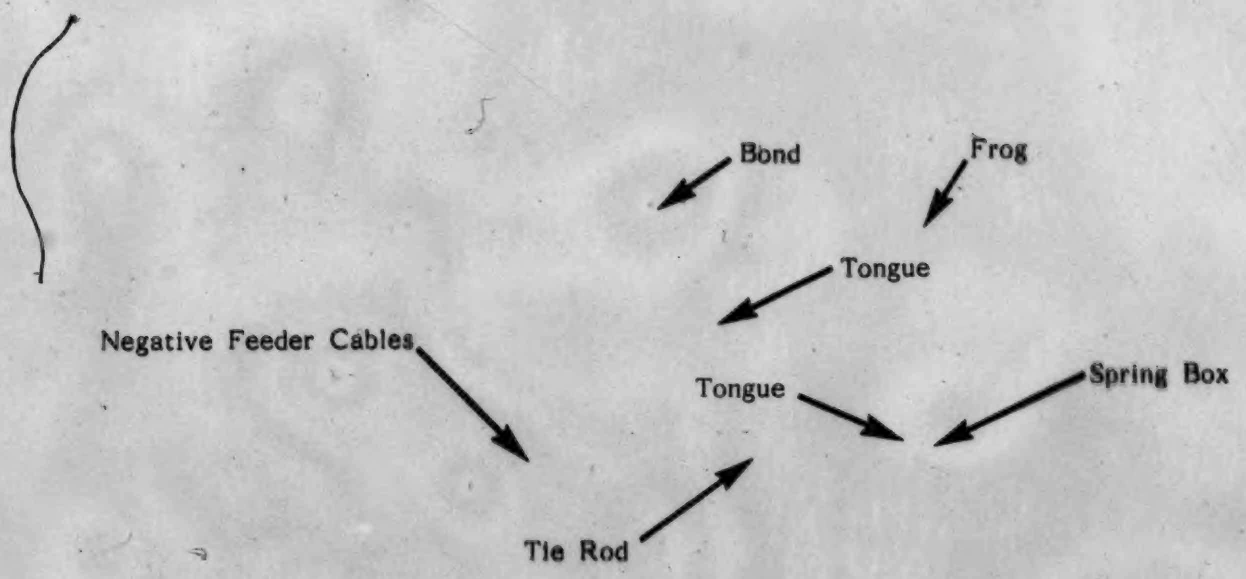


FIGURE 13. PLAN OF THREE-PART THROUGH Y

Installation of the special work was accomplished in a manner similar to that used for the installation of permanent tangent track. After the sub-grade, which conformed to the shape of the special work, had been prepared and the 6 inch (152 mm) thick concrete slab poured and hardened, crews deposited a 1 inch to 2 inch (25.4 mm to 51 mm) thick layer of sand over the entire surface. Standard size fir ties were then placed on the sand-covered slab at intervals of 2 feet (610 mm), measured centre to centre. The ties were also placed so that they would lie beneath the special work. (CEED Drawing S.R.13 #4, February 1913, and ERR Drawings showing standard tie layouts for various pieces of special work, 1913)

The parts of the special work were laid on the ties in their correct locations, according to the numbers on the blueprint and by the numbers painted on the ends of the parts. When all parts were accounted for and were located properly, the pieces were bolted together at the ends using angle bars and track bolts. Proper track gauge was maintained by means of tie rods. Tie rods were rectangular bars of steel which were installed between the rails at varying intervals. (Hadfields Steel Foundry blueprints and Lorain Steel Company blueprints, 1912-1913) The tie rods had threaded rods formed at either end which were designed to be placed in holes drilled through the webs of the rails. Tie rods were held in place by nuts that were placed on the ends of the rods and tightened against the webs of the rails. If installed properly, the tie rods would ensure the correct track gauge throughout the entire special work. Plate 10 (Provincial Arhives of Alberta) shows crews assembling the grand union at Ninth (109th) Street and Jasper Avenue. The placement of the ties as well as the tie rods should be noted.

In the next step of the assembly, the special work was attached to the ends of the tangent rails. If the adjoining rail was the same height as the rail in the special work, standard angle bars could be used. In many instances, however, the special work had to be connected with 80 pound per yard (33.2 kg/m) ASCE T-rail which was shorter than the grooved girder guard rails used. Special angle bars known as "compromise angle bars" were used to join ASCE rail to the rails in special work.


Bond
Frog
Tongue
Negative Feeder Cables
Tongue
Spring Box
Tie Rod

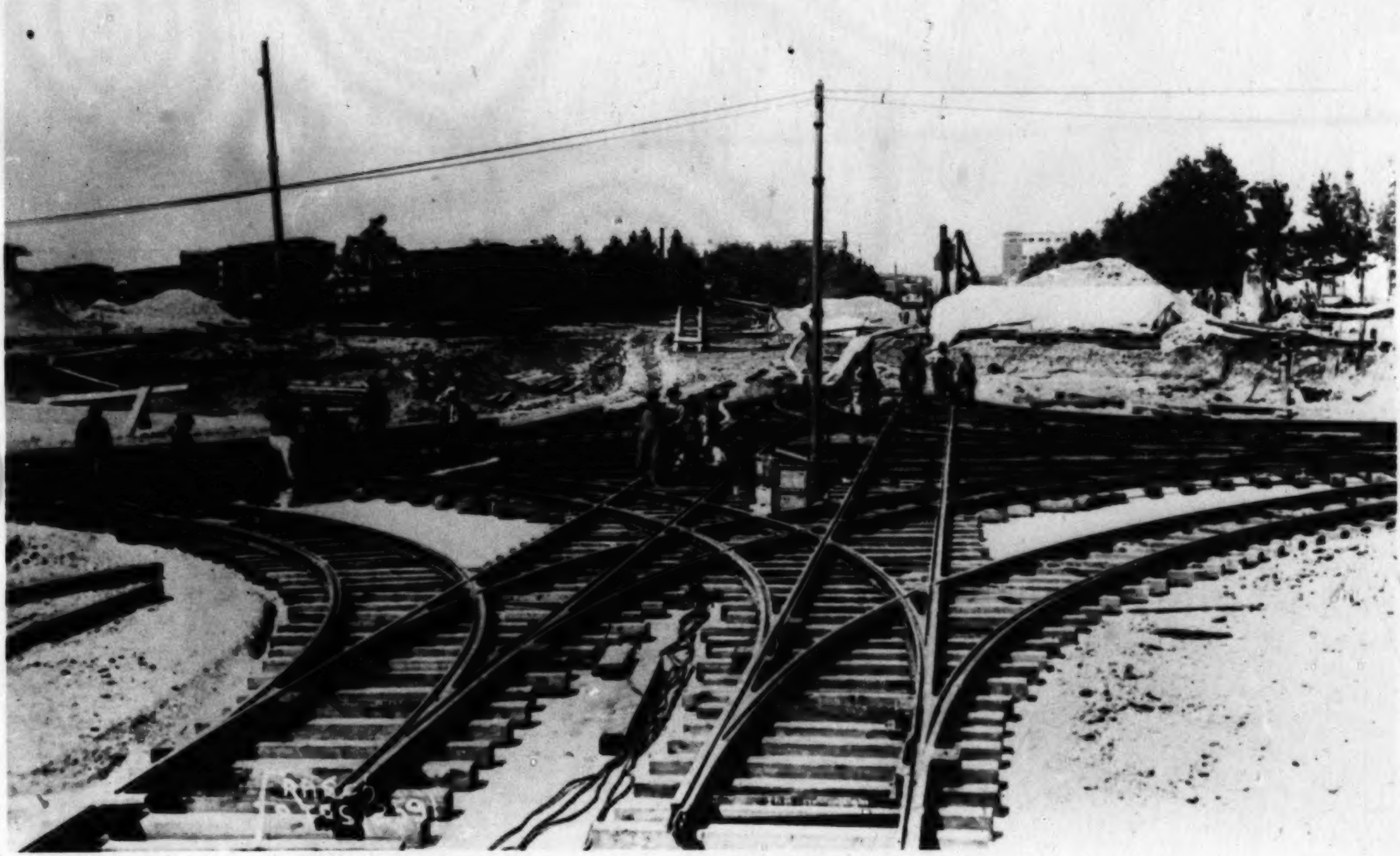


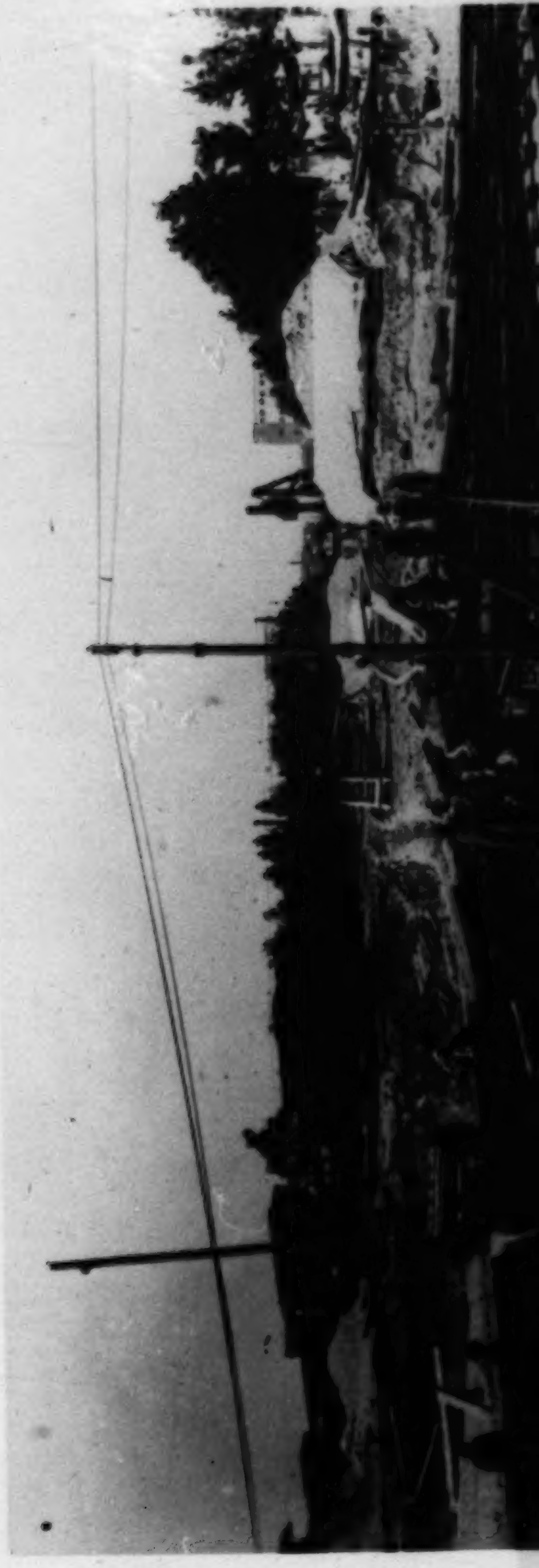
Plate 10. (Provincial Archives of Alberta) Construction of Grand Union, 1913

(ERR Drawing of a compromise rail joint, May 1913) A compromise angle bar was similar in basic design to a standard angle bar. The difference was that one half of the compromise angle bar fitted the grooved girder guard rail while the other half fitted the shorter ASCE T-rail. Compromise angle bars were attached to the rails by means of track bolts. When all connections were made, concrete was poured between the rails of the special work until the tops of the ties were covered.

The final step in the installation of special work was the construction of the pavement. The method used was similar to that used for tangent track. The only difference was that flangeways did not have to be formed since the lip of the grooved girder guard rail had already provided a flangeway. When the pavement had hardened, the installation was considered complete.

The locations of the permanent special work installed during 1913 can be seen on Map 8 (after Official Map of the City of Edmonton, 1938, CEAR, 1913, pp. 286-287, ERR Drawings of special work, 1913).

At this juncture, descriptions and explanations of the types of special work switches (sometimes known as points) will be given. Most standard railway switches used after 1900 were called movable switches. This type of switch, frequently used in ERR temporary construction, consisted primarily of two interconnected movable sections of tapered rail, known as tongues. (Dover, 1929, p. 537, and ERR Drawings of standard switches, 1913) In the normal running position, one tonue fitted against the inside head of one of the running rails, the other tongue rested far enough away from the rail head to allow a flanged wheel to pass unhindered. A streetcar entering a switch in this position would travel straight through. When someone "threw" the switch, usually by moving a lever arrangement called a switch stand, the position of the two tongues would



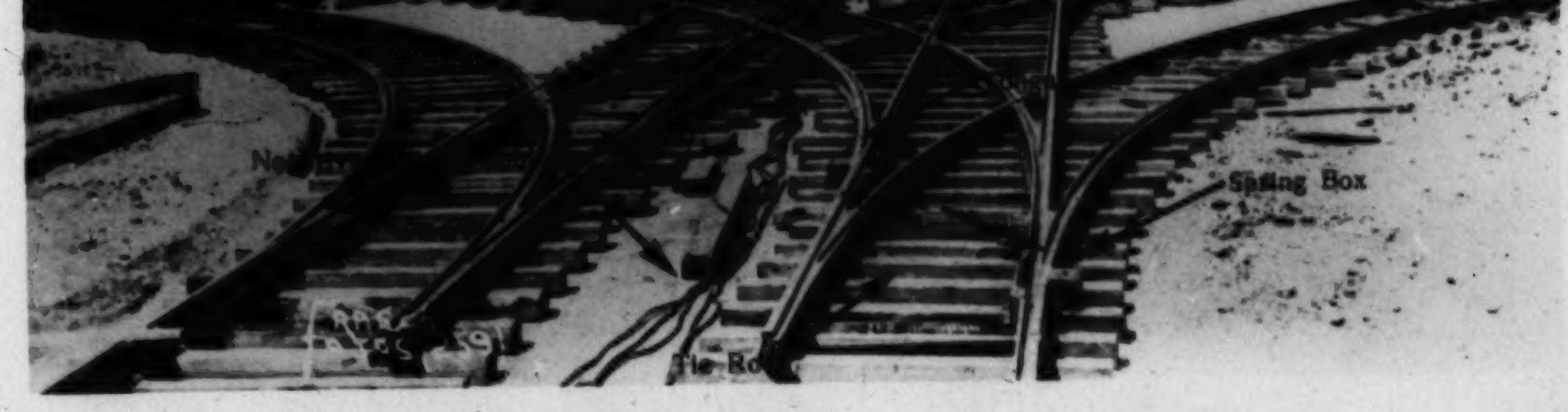

Spring Box
Tie Ro

Plate 10. (Provincial Archives of Alberta) Construction of Grand Union, 1913 be reversed. The result would be that a streetcar entering the switch would be diverted to another track. This occurred because the tongue that was now against the rail head curved away from the direction of the through track and directed the flanged streetcar wheel through a frog and onto another track. The wheel on the other end of the axle would take the curve because the tongue that had been against the rail head now provided a curved path to the divergent track. This operating principle was applied to some switches found in street railway work. Movable switches were usually found in branch-offs, crossovers and three-part Y's. (Dover, 1929, p. 537) Although special work movable switches were similar to ordinary railroad switches, there were several differences. Where railroad switches were usually thrown by means of a switch stand, special work switches on the ERR were usually thrown by means of a switch iron. (Dover, p. 537) A switch iron consisted of a steel rod, usually about 3 feet (0.91 m) in length, that had a handle at one end and a flat vertical blade at the opposite end. To throw a switch, the motorman (operator) of the streetcar stopped before reaching the switch tongues. With most ERR streetcars, the motorman had to step onto the street in order to be able to throw the switch. When he arrived at the switch tongues, the motorman inserted the blade of the switch iron between one of the tongues and the rail heads and then pushed the tongues over to the opposite position, using the switch iron as a lever. The streetcar could then proceed. The tongues were held in position by an arrangement of strong springs and levers located in steel boxes at either side of the tongues. Examples of these spring boxes are indicated on Plate 10. Another difference between standard movable railway switches and special work movable switches was that the tongues of the special work switches were located within grooves. This was necessary because such switches were normally located on paved streets and it was essential that the paving material not interfere with the movement of the switch tongues. In addition, most special work was made with grooved girder guard rail and in order to continue the protection of the guard feature throughout the special work, it was necessary to place the switch tongues within grooves. (Dover, pp. 534-539) There were other types of special work switches used on the ERR besides the movable tongue type.

When it was necessary for a streetcar to enter a track through a three-part Y, for example, it was first necessary for a movable switch to be thrown. When the streetcar had entered the curved section of the special work, it approached another switch and the tongues would be pointing away from the streetcar. If the switch was a basic movable tongue switch, the motorman would have to get out and walk to one of the tongues and throw the switch. To avoid this problem, a switch known as an automatic, trailing or spring switch was used. A spring switch was virtually identical to the movable switch except that the spring switch could be thrown by the passing of the streetcar wheels through the switch. Since the switch was arranged in the opposite manner to a movable switch, the flanges of the streetcar wheels would push against the switch tongues and force them over. After the streetcar had passed, springs in the switch would return the tongues to their original position. (Dover, p. 537) By using spring trailing switches, an additional stop was eliminated in the travel of the streetcar.

A third type of switch was used in complex special work such as grand unions and three-part through Y's. It was called an open switch, sometimes referred to as an open point. (Dover, p. 537) Open switches, which were used in connection with a modified form of the movable tongue switch, did not have tongues similar to those described previously. (Dover, pp. 535-537) Upon approaching an open switch one would observe a short tongue on one track. On the adjacent track, further along, there would be a piece of track work that resembled a tongue fixed between normal positions. Immediately beyond this "fixed tongue", there would be another short movable tongue. On the opposite rail there would be a second fixed tongue a short distance along. This arrangement can be seen in Plate 10. It should be noted that the small movable tongues were not interconnected. The operation of an open switch was fairly simple. When approaching the special work the motorman would stop the streetcar and would walk to the first small movable tongue. Depending on its position, the streetcar could proceed straight or could be diverted onto the first turn. If the streetcar were supposed to travel straight through the special work, the motorman would approach the second small movable tongue and would position it so that the second turn would not be taken. Since the movable tongues were located before the fixed tongues, the streetcar's wheels would follow the path determined by the positions of the small movable tongues. With this arrangement, a streetcar could go in one of three directions. Open switches were also used on car barn special work. (Lorain Steel Company blueprints showing layout of special work at new car barns, 1913)

Temporary Construction, 1913

Although most of the track constructed in 1913 was permanent track, a total of 7.67 miles (12.34 km) of single and double temporary track, measured as single track, was built. (CEAR, 1913, p. 287) Two types of temporary construction were employed. They were known as type A and type B. Type A, which was a new form of construction, was intended to be used on graded roads with frequent vehicular traffic. Type B, which was similar to 1908 temporary construction, was intended to be used on right of ways or on rarely used roads. (ERR Drawings of temporary track construction, 1913)

Type A construction was usually double-track. Construction began following the grading of the road. The first step in the track construction was the excavation of a straight-sided trench along the centre of the road. The trench was intended to be 15 inches (381 mm) deep and 19 feet (5 791 mm) across. Following the excavation, a layer of gravel approximately 4 inches (102 mm) thick was deposited along the bottom of the trench. Standard fir ties were then placed on top of the gravel in two rows. The ties in each row were spaced 2 feet (610 mm) apart, measured centre to centre. Each row was so placed that, when complete, the centres of the two tracks would be 10 feet (3 048 mm) apart. When the ties were placed in their proper positions, 33 foot (10 006 mm) lengths of 80 pound per yard (33.2 kg/m) ASCE T-rail were placed on the ties. The rail sections were joined using continuous angle bars. Following this, the rails were aligned and spiked to the ties. Gravel was then deposited around the rails until it came within ½ inch (12.7 mm) of the top of the rail heads. Between the running rails, however, the gravel was crowned. (ERR Drawing of Standard Temporary Double Track Type A, 1913) When the gravel was deposited and tamped into place, the construction was considered complete. Figure 14 (after ERR Drawing of Standard Temporary Double Track Type A, 1913) shows a cross-section through type A temporary double track. Although the original drawing dates from 1913, minor deletions as well as the metric conversion were made by this author.

Type B temporary track was usually single-track. The preparation of a suitable sub-grade was the first step in construction. A graded surface approximately 14 feet (4 267 mm) across was prepared along the route of the track. The sides of the sub-grade were to slope 60° down from the graded surface. Drainage ditches were to be formed at convenient distances below the graded surface. (ERR Drawing of Standard Temporary Single Track Type B, 1913) Following the completion of the sub-grade, a 6 inch (152 mm) thick layer of gravel or broken stone was deposited along the graded surface. Standard fir ties spaced 2 feet (610 mm) centre to centre were then laid on the gravel. In the next step, lengths of 60 pound per yard (24.9 kg/m) ASCE T-rail were placed on the ties. The rail lengths were joined by ordinary single bars. The rails were then aligned and spiked to the ties. Another layer of gravel or broken stone was deposited. However, this layer was deposited between the rails until even with the tops of the rail heads. The final step of the construction consisted of shaping the gravel or broken stone so that it sloped away from the centre of the ties, past the ends of the ties to the graded surface. (ERR Drawing of Standard Temporary Single Track Type B, 1913) The appearance of type B temporary track was similar to the 1908 type of temporary construction. The longest

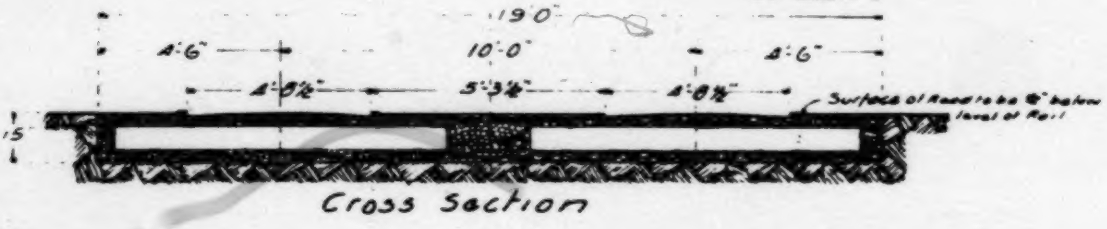


FIGURE 14. TYPE A TEMPORARY CONSTRUCTION

distance of type B temporary construction built in 1913 was along 6th Avenue South (76th Avenue) between 2nd Street West (106th Street) and 12th Street West (116th Street). (CEAR, 1913, p. 287) This 1.246 mile (2.0 km) section of track was later known as the "McKernan's Lake Line". In 1913, and for many subsequent years, there were few buildings near the line. It was built to satisfy the requirements of the Edmonton-Strathcona Amalgamation Agreement. (CEAR, p. 287, and Statutes of Alberta, 1911-1912, Chapter 66, pp. 529-530).

Maps 8, 9 and 10 (after Official Map of the City of Edmonton, 1938, and CEAR, 1913, pp. 286-287) show the locations of all temporary track constructed during 1913.

Freight Track, 1913

The ERR, through its new interchange with the CNOR, constructed at the new Cromdale barns, was able to provide faster distribution of goods to its customers in the northern parts of Edmonton. (ERR Drawings showing layout of tracks at new car barns, 1913, and CEAR, 1912, p. 207) In addition to the interchange, two new spur tracks were constructed.

One spur was constructed south from the southern or east-bound track on Alberta (118th) Avenue between Duprau (68th) and Wadleigh (67th) Streets, into the yard of E. Bashaw and Sons, sash and door manufacturers. (North Edmonton Industrial Review, 1913) This firm later became the Graves Lumber Yard. (Henderson's City Directory, 1925) The other spur was built to serve the wholesale jobbing firm of Robarts and Boon which was located on Syndicate Avenue (95th Street) between Griesbach and Sutherland Streets (105A and 106th Avenues). (Henderson's Edmonton City Directory, 1914) The track branched off to the northeast from the single track on Syndicate Avenue (95th Street) and proceeded in an easterly direction into the Robarts and Boon yard.

Freight track construction methods were usually constructed to the type B temporary track standard. Freight spurs were not usually ballasted, however. (See Plate 7) The location of the freight spurs constructed in 1913 can be seen on Maps 8 and 9.

Track Removal, 1913

Two temporary track stub-lines became redundant in 1913 as the result of the installation of permanent through-lines nearby. One of the stub-lines so affected was located on Vermilion (106th) Avenue. (See Maps 4 and 6) Although the line served a residential area, the revenue received was substantially less than the operating costs. (CEAR, 1910, p. 111) By 1912, a track connecting 1st (101st) Street and 24th (124th) Street was desired. Nelson (107th) Avenue was selected primarily because it provided a direct route. The Vermilion (106th) Avenue route would have had to have been diverted around the Edmonton Cemetery. (Edmonton Journal, May 1, 1912, p. 2) For these reasons, the Vermilion (106th) Avenue line was abandoned and the track removed.

The other stub track to be removed was the single-track line between Whyte (82nd) Avenue and 5th Street North (87th Avenue). The line did not have heavy ridership as the result of infrequent service. In addition, only double-end streetcars could be used since the line had no facility at its terminus for turning this type of streetcar around. The opening of the High Level Bridge provided very frequent streetcar service, both north-bound and south-bound. The distance from the High Level Bridge lines to the buildings of the University of Alberta was about the same as the distance between the end of the stub-line and the buildings. No justification for retaining the stub-line could be found by administrative personnel. It was, therefore, removed.

With the completion of the new Cromdale streetcar barns located at Beech (117th) Avenue and John (80th) Street, the ERR's original facility located on Syndicate Avenue (95th Street) became obsolete. The building was leased to the Edmonton Public School Board as a Technical School. (CECR No. 607, April 13, 1914) The tracks to the building were no longer required and they were removed. In addition, the trackage behind the old car barns was also removed. The removal did not include the short freight spur to Rendall, MacKay and Michie installed in 1912. (SRDMR, June-December 1913)

Permanent Construction, 1914

It would appear, from the large distances of track constructed in 1913 and the reported increase in City population, that the ERR would continue to expand rapidly. (CEAR, 1913, pp. 285-289) This was not to happen, however. Towards the end of 1913, it had become apparent that ridership on the ERR had stabilized and had not risen to the levels anticipated. In addition, the ERR incurred a heavy deficit as the result of several newly constructed lines not earning adequate revenue. (CEAR, p. 15, p. 45, p. 289) In consequence of these developments, it was decided by many City officials that large track construction projects were to be avoided until the track already constructed was more fully used. (CEAR, p. 15) A total of 2.745 miles (4.42 km) of permanent double-track was constructed, however, in 1914. (SRDMR, December 1914, n.b. the report lists the total distance of double-track constructed as 4.01 miles (6.45 km) The figure included the 1.265 mile (2.04 km) section of track on Portage (Kingsway) Avenue that was not completed until

1916. It should be noted that most of this construction replaced single and double temporary track laid in previous years. It appears, therefore, that former Superintendent Knight's policy of replacing temporary track with permanent track was still being followed. The largest portion replaced was along Nelson and Short (107th) Avenue between 11½ Street (no longer extant; between 111th and 112th Streets) and 24th (124th) Street. (SRDGL, Account C4A) One double-track extension was started in 1914 along Portage (Kingsway) Avenue. This extension was begun as the result of an agreement between the City and the Hudson's Bay Company which owned the land where Portage (Kingsway) Avenue lay. In essence, the Hudson's Bay Company agreed to underwrite the costs of paving Portage Avenue if the City would construct a double-track streetcar line along the road. One third of the construction was to take place in 1914. Tracks were laid along Portage Avenue between 1st (101st) Street and Norwood Boulevard (111th Avenue). (Edmonton Official Gazette, April 2, 1914, p. 45) It should be noted that special work was not installed at 1st (101st) Street so the tracks on Portage Avenue were not connected to the ERR. Map 8 (after Official Map of the City of Edmonton, 1938, CEAR, 1913, pp. 285-287, and Edmonton Official Gazette, April 2, 1914, p. 45) shows the locations of the permanent track constructed in 1914.

Although the concrete slab type of construction was used in 1914, several modifications were introduced that distinguished it from the type used in 1913. The construction procedure was unaltered until after the crews deposited the layer of sand on the hardened concrete slab. Following the deposition of the sand layer, crews placed a layer of expanded metal mesh over the sand. The mesh was intended to reinforce the next layer of concrete deposited. (CEED Drawing of 1914 Street Railway

Construction) The ties were then placed on the metal mesh at 2 foot (610 mm) intervals. Rails were then placed, connected, aligned and spiked to the ties by the same methods that were used in 1913. The preparation of the paved surface was the final step in the construction. Concrete was first deposited around the ties until the bases of the rails were covered. When the concrete had hardened, shaped sandstone blocks were fitted against facing webs of the rails in order to provide flangeways. The blocks were held in place with a mortar mixture. (CEED Sketch Showing Detail of Sandstone Set, 1914) A third layer of concrete was then deposited between the rails and around the sandstone blocks as well as outside the rails to the sides of the trench. This layer of concrete was intended to be even with the bottoms of the rail heads. The final surface, which came within ¼ inch (6.4 mm) of the tops of the rails consisted of an asphaltic or bituminous compound. The asphaltic surface, which was even with the tops of the sandstone blocks and even with the sides of the trench, was crowned to provide drainage of the trackage area. (CEED Drawing of Cross Sections of Double Tracks, 1914) Construction was considered finished following the completion of the asphaltic surface.

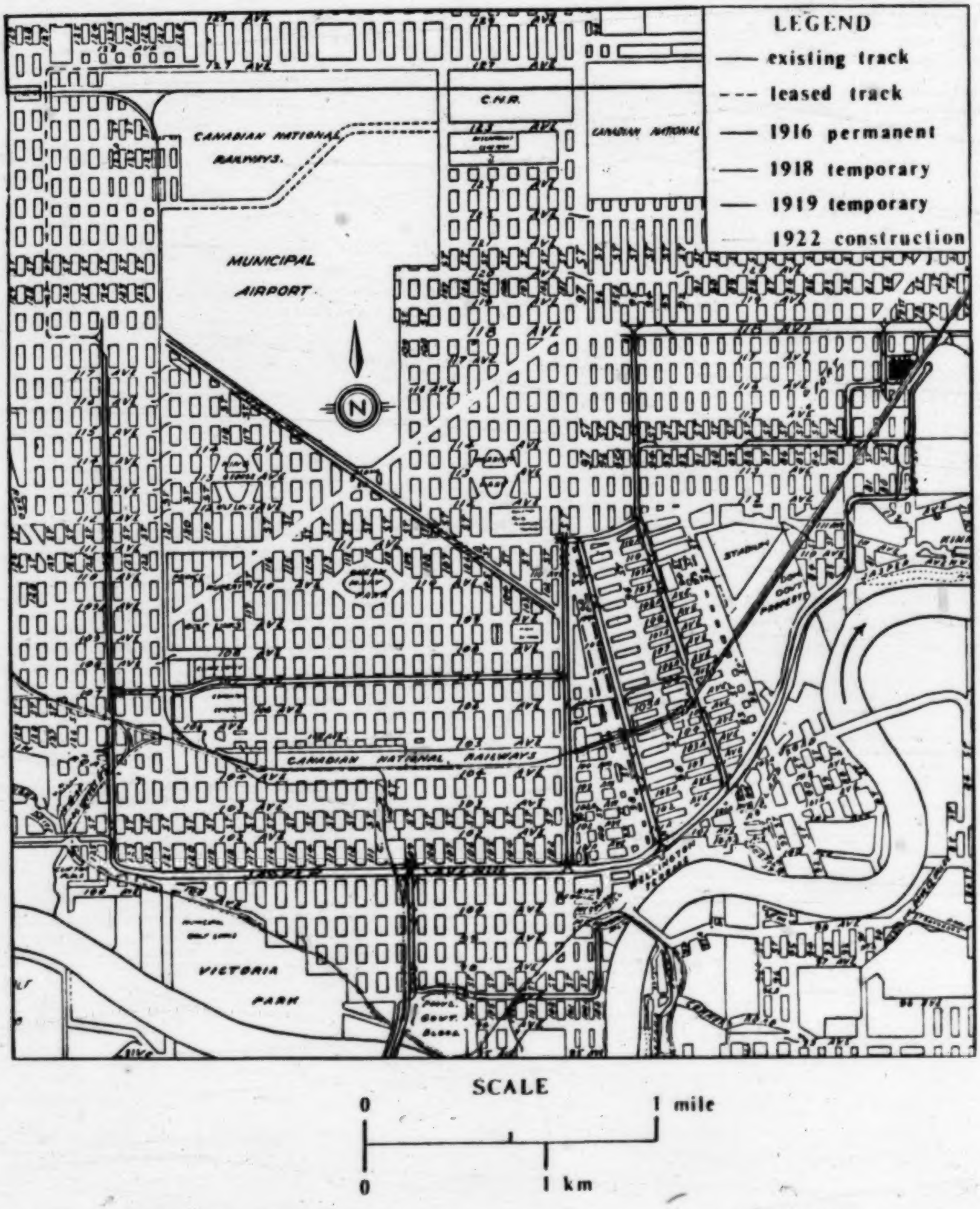
Permanent Construction, 1915

It was mentioned in the previous section that stable ridership and high deficits were the major reasons for the curtailment of large construction projects. In addition, the start of the First World War in August 1914 contributed to a further drop in ERR ridership as well as to a drop in Edmonton's population. (Yorath, 1924, p. 45) In consequence of these factors, a very small amount of construction was undertaken during 1915. Most of the construction consisted of the building of another portion of the double-track line on Portage (Kingsway) Avenue. Tracks were laid from Norwood Boulevard (111th Avenue) to Oak (116th) Avenue. (Canadian Railway and Marine World, November 1915, p. 441) The concrete slab type of construction was employed again. The 1915 style of construction reverted to the methods used during 1913. The sandstone blocks and the wire mesh used in the 1914 construction method were dispensed with. Unlike the 1913 construction, however, the final layer of concrete was not reinforced with wire mesh, and the surface was not scored to resemble bricks. The reduction of construction costs appears to have been the major reason why the 1914 method of construction was abandoned. (CECR No. 38, February 16, 1915) In a manner similar to that used in 1913, the flangeways were formed with templates before the concrete hardened. (CEED, Drawings of 1915 Street Railway Track Construction) The only other construction to take place during 1915 was the installation of two pieces of special work near the High Level Bridge. (CECR No. 38, February 16, 1915)

It had been mentioned, in a previous section that described 1913 permanent construction, that the approach tracks to the High Level Bridge allowed streetcars to traverse the bridge on tracks that were on either side of the central CPR track. It was also mentioned that single-end cars had a safety problem with this arrangement, their doors opened directly onto a long drop to the river. In order to eliminate this problem, the ERR and the City Engineers decided to install crossings at both ends of the bridge so that north-bound streetcars would use the western track where they had formerly used the eastern track. Conversely, south-bound streetcars would use the eastern track where they had previously used the western track. With the crossings, the doors of single-end streetcars now faced the CPR track, a preferable means of escape in case of emergency, to the long drop to the river. After a streetcar had crossed the bridge, it would pass through the other crossing, thereby returning to the proper side of the street. The two crossings were built by the Lorain Steel Company in 1914. They consisted of 80 pounds per yard (33.2 kg/m) ASCE T-rails and 4 frogs each. (Lorain Steel Company blueprints of Crossings for High Level Bridge, 1914) The crossings were installed during 1915. (CECR No. 38, February 16, 1915) In order to install the crossings, some of the existing permanent track had to be removed or re-aligned. Figure 15 (after CEED Drawing of North Approach to the High Level Bridge, 1915) shows the plan view of the crossing installed at the north end of the High Level Bridge. The location of the old approaches to the bridge should be noted. The location of 1915 construction can be seen on Map 8.

Permanent Construction, 1916

A further drop in ridership during 1915 discouraged the ERR from considering the construction of substantial extensions to the permanent track. (Yorath, 1924, p. 45) In consequence, the only new permanent track constructed was the final portion of the double-track line on Portage (Kingsway) Avenue between Oak (116th) Avenue and 21st (121st) Street. (Edmonton Journal, October 9, 1916, p. 3) See Map 11 for location. The use of the concrete slab type of construction was continued but some changes in the method of pavement construction were introduced. After the sub-base, base, ties and rails had been prepared in accordance with the methods described for 1913, crews applied a coating of mastic, a resin-based water proofing compound, to both sides of each rail. In addition, a treated wooden filler strip was installed between the bottom of the rail head and the top of the rail foot on the sides of the rails


LEGEND
existing track
leased track
1916 permanent
1918 temporary
1919 temporary
1922 construction
C.N.R.
CANADIAN NATIONAL RAILWAYS.
CANADIAN NATIONAL
MUNICIPAL AIRPORT
N
CANADIAN NATIONAL RAILWAYS
STADIUM
DOM. GOVT. PROPERTY
WELLINGTON TERRACE
VICTORIA PARK
PROV. GOVT. BLDGS.
SCALE
0
1 mile
0
1 km

MAP II. EXTENT & TYPE OF CONSTRUCTION
1916 – 1922

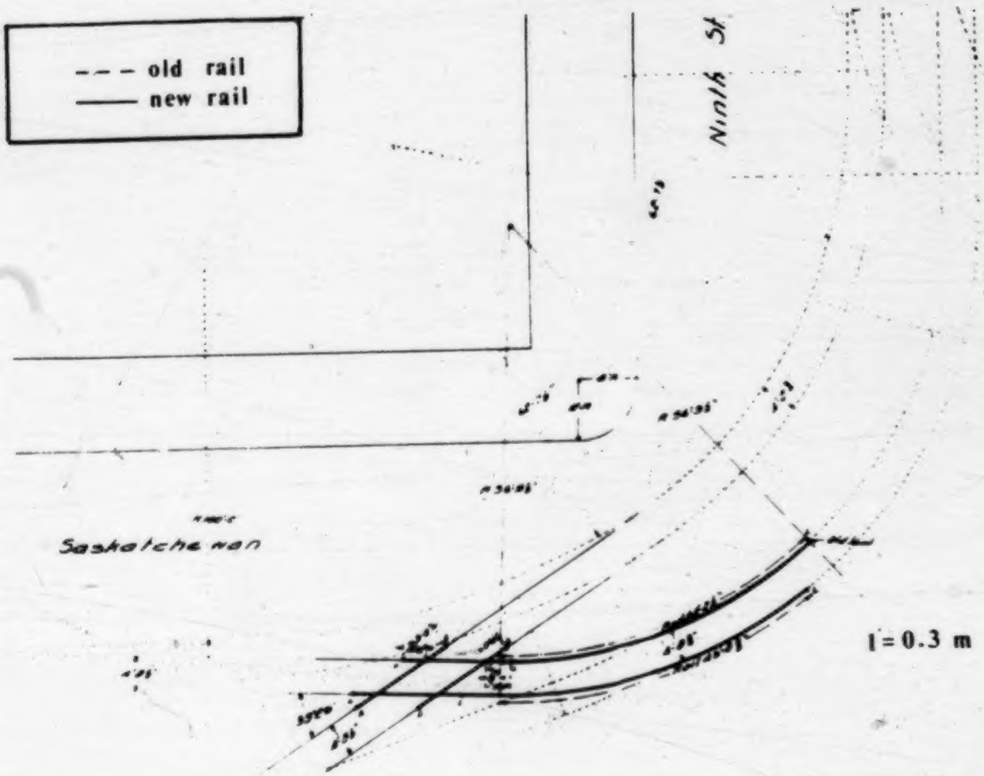


FIGURE 15. NORTHERN CROSSING NEAR HIGH LEVEL BRIDGE

that faced the sides of the trench. (CEED Cross-sectional drawing of 1916 track construction) The purpose of the filler strip was to provide a relatively flat surface on that particular side of the rail in order to facilitate a subsequent step of the construction. When the filler strip had been installed and secured with mastic, a thin layer of concrete was deposited on top of the ties between the ends of the ties and the rails. The concrete sloped away from the rails towards the edges of the trench. When the concrete had hardened, the surface was coated with a layer of mastic. Two rows of 3½ inch square (89 mm^2) wooden blocks were placed next to the sides of the rails with the filler strips. The two rows of blocks were separated by a layer of mastic. (CEED, Cross-sectional drawing of 1916 track construction) The purpose of the blocks was to impart some lateral flexibility to the pavement. As a result of extreme temperature fluctuations in Edmonton, the resiliency of the blocks was thought to reduce the problem of the pavement cracking next to the rails. Following the installation of the blocks, a 4 inch (102 mm) layer of concrete was deposited between the rails. When levelled, this layer of concrete was ½ inch (13 mm) below the top of the rail heads. Before the concrete hardened, flangeways were formed with templates. In addition, 2½ inch (63.5 mm) deep expansion joints were formed in the concrete 7 inches (178 mm) from the rail heads, running parallel with the rails. (CEED Cross-sectional drawing of 1916 track construction) In the area between the sides of the trench and the tracks, a layer of concrete was deposited that covered, approximately, half the height of the wood blocks. When the concrete had hardened, asphalt was deposited on top until it was even with the tops of the wood blocks and even with the sides of the trench. Figure 16 (after CEED Cross-sectional drawing of 1916 track construction) shows the appearance, in cross-section, of the permanent construction just described. Although the original drawing has been presented, minor deletions and additions were done by this author.

Leased Trackage, 1916-1921

In December 1913, a private railway known as the Edmonton Interurban Railway (EIR) connected its line running from the Town of St. Albert to the terminus of the ERR track on 24th (124th) Street and

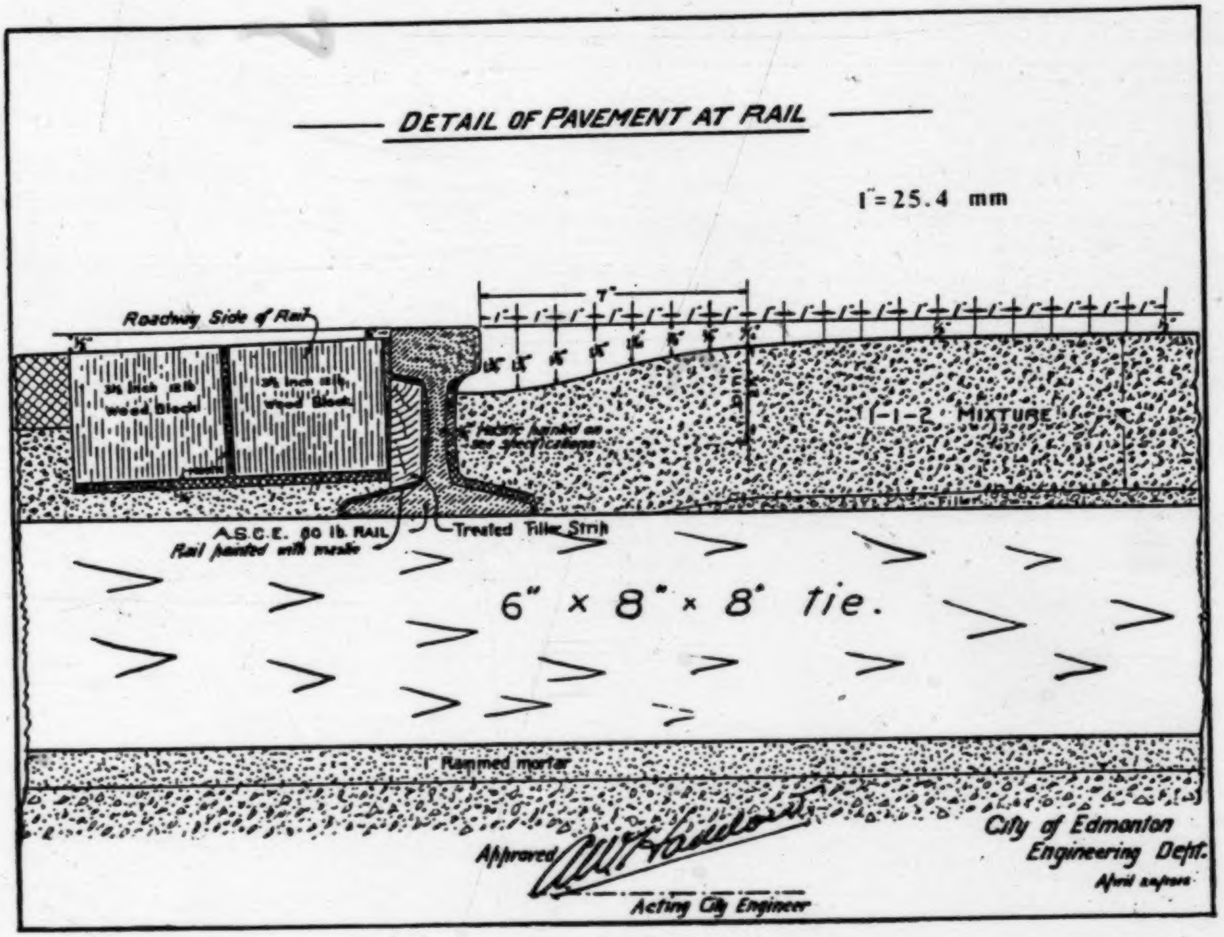

DETAIL OF PAVEMENT AT RAIL
1" = 25.4 mm
Roadway Side of Rail
7"
1"
wood Block
wood Block
1-1-2 MIXTURE
A.S.C.E. 80 lb. RAIL
Rail painted with
Treated Filler Strip
6" × 8" × 8' tie.
1" Rammed mortar
Approved
Acting City Engineer
City of Edmonton
Engineering Dept.

FIGURE 16. CROSS-SECTION OF 1916 PERMANENT CONSTRUCTION

Alberta (118th) Avenue. The EIR's revenue-earning rolling stock consisted of one self-propelled interurban streetcar which was moved by electric motors. The motors received their power from an on-board generator which was powered by a gasoline engine. (Canadian Railway and Marine World, March 1914, p. 135) It was, therefore, easy for the EIR's interurban streetcar to travel along ERR trackage. It was not possible, though, for ERR streetcars to use the EIR track since there was no electrical distribution system on EIR lines. When the EIR's interurban streetcar burned in 1914, their line could not be used. Many residents of both Edmonton and the Town of Calder, which was located immediately north of Edmonton, urged the City to provide streetcar service to Calder. The ERR and the City did not have the financial resources necessary to construct an extension to Calder. The City, therefore, negotiated with the directors of the EIR with the intent of leasing a portion of that railway's trackage. An agreement between the City and the EIR was concluded in September 1915. (Canadian Railway and Marine World, October 1915, p. 404) The length of the EIR track leased was 1.13 miles (1.8 km), all of it built to a standard that resembled ERR temporary track constructed before 1913. (Canadian Railway and Marine World, February 1917, p. 71) Before the ERR could operate the leased section, two important actions had to occur. Overhead wire for electrical distribution had to be installed. This work was done early in 1916. (Canadian Railway and Marine World, February 1916, p. 73) In addition, the ERR had to obtain permission from the BRC in order to reinstall the crossing with the GTP on 27th (127th) Street between Armstrong (126th) and Cochrane (126A) Avenues. The BRC gave its approval to the ERR for the installation of this crossing in August 1916, with the proviso that the ERR install a half interlocking plant to protect the crossing. (Canadian Railway and Marine World, September 1916, p. 378)

A half interlocking plant consisted of two derails installed on one of the intersecting tracks, the derails being placed on either side of the crossing. Derails were metal devices that could be placed on top of a rail. They were designed to prevent any vehicle using the track from proceeding unless authorized to do so. The derails accomplished this by causing one set of wheels to lift from the rail head and to travel off the track. The derails, which were located several yards (metres) before the crossing, were interlocked with two sets of signals, one set for each intersecting line. The signals on the line with the derails would normally be set in the stop position, while the signals for the other line would normally be set in the proceed position. (Harding & Ewing, 1926, pp. 240-256) The entire installation was referred to as a half interlocking plant. (CNR Drawing of half interlocking plant on 107th Avenue, 1923) The signals were usually of the semaphore type (i.e. they had a movable board or "arm" as well as colored lights to indicate stop or proceed) but many were replaced several years later by signals that displayed colored lights only. A full interlocking plant, which was usually installed at the intersection of two heavily-used steam railroad lines, consisted of derails and signals installed on both intersecting lines. (Harding & Ewing, 1926, pp. 240-256)

The ERR track had the derails installed. With the half interlocking plant, GTP trains could, usually, proceed unimpeded through the crossing. For ERR streetcars to cross the GTP track, however, a watchman had to move the derail away from the top of the rail after he had determined that no train was approaching. The watchman, by means of levers, would then move the ERR signal to the proceed position and would also move the GTP signals to the stop position. The streetcar could then proceed through the crossing. Once the streetcar had passed through the crossing, the derail and the signals would be returned to their normal positions. A similar half interlocking plant had been installed on the ERR track on Nelson (107th) Avenue in 1914. (Edmonton Official Gazette, April 2, 1914, p. 45, and information located on CNR drawing of half interlocking plant on 107th Avenue, 1923) The purpose of an interlocking plant was to prevent accidents between trains and streetcars, although accidents did sometimes occur in spite of the protection. All the crossings between the ERR and steam railroads were not protected by interlocking devices. It was the prerogative of the BRC to decide whether a crossing needed protection or not. Unless the steam railroad had a heavy traffic flow, and could prove this to the satisfaction of the BRC, the BRC would not order the ERR to install protection. It is for this reason that most of the ERR crossings with steam railroads, including the crossings at either end of the Low Level Bridge, were not protected. (BRC Orders, Numbers: 5608, November 3, 1908; 5598, November 12, 1908; 5691, November 24, 1908; 6410, February 19, 1909; 6751, February 19, 1909)

Following the installation of the half interlocking plant, the ERR placed the leased portion of the EIR track in service. The track was leased from the Directors of the EIR until the end of 1921, at which time it was purchased outright by the City of Edmonton. (SRDGL, Account F19) The location and extent of the track leased from the EIR may be seen on Map 11.

Reconstruction, 1916

It had been believed by many City officials that the concrete slab method of permanent construction introduced in 1913 was superior to the construction methods that had been used previously because it was thought that the 1913 permanent construction would last for "at least fifteen years" (CEAR, 1913, p. 286) Towards the end of 1915, however, one particular section of double-track had deteriorated to such an extent that some streetcars were derailing. The track was located on Alberta (118th) Avenue between Kirkness (95th) and Douglas (78th) Streets. (CEAR, p. 285) See Map 8 for the location. The problem with the track was that it was bending down at the rail joints. This caused the streetcars to bounce as they travelled along the track. (CECR No. 248, November

29, 1915) It should be remembered that continuous angle bars were used in the construction. No provision for tie placement near the joints was specified, however. As a result of ambiguous plans, the crews who constructed that section of double-track did not place the ties near the rail joints. The stress on the unsupported joints was sufficient to bend the rails at those points. In addition, since tie plates were not used, the rails tended to crush the ties and also tended to pulverise the surrounding concrete fill. The track eventually became so loose and undulating that major repairs were required in order to prevent serious and frequent derailments. (CECR No. 248) The blame for sub-standard construction of this track was directed towards the former Superintendent, W. T. Woodroofe, who had insisted on not using tie plates. Woodroofe was unable to answer the charges because he had resigned from the ERR in April 1914 and was no longer in Edmonton. (Canadian Railway and Marine World, April 1914, p. 185) In fairness to Woodroofe, some of the blame should have been directed to other ERR personnel as well as to the City Engineer who were responsible for the faulty tie placement. In any event, the ERR reconstructed the double-track on Alberta (118th) Avenue during 1916. The deterioration of the double-track on Alberta Avenue prompted some City officials to wonder whether the 1913 permanent construction actually would last the estimated fifteen years. (CECR No. 248, November 29, 1915)

In addition to the reconstruction of the double-track on Alberta (118th) Avenue, several pieces of special work were replaced. The special work that was replaced consisted of 9 crossings (sometimes called "diamonds") with railroads, portions of the three-part Y at the intersection of 97th Street and Jasper Avenue, and the three-part Y at the intersection of 1st (101st) Street and Jasper Avenue. (CECR Nos.: 253, November

29, 1915; 121, June 5, 1916; 165, July 25, 1916) After reading the previous paragraph, one might speculate that the special work required replacement because of poor installation, or because of poor maintenance. Neither poor installation nor poor maintenance were reasons why the special work was in need of replacement. It has been mentioned in previous sections that most special work was made with hard-wearing steel alloys, primarily manganese steel. It should be noted, however, that most of the special work in need of replacement had been in service since 1908, and the frequent numbers of streetcars using the special work wore out the switch tongues, curved grooved girder guard rails, and the frogs. Maintenance of special work had been, and continued to be, a prime concern of the ERR.

As early as 1911, the ERR had employed a number of men who, in the summer months, were required to walk along sections of the track with pails of grease and short wooden sticks. These men, known as "track greasers", were supposed to apply grease to the sides of the rail heads on curves, using the sticks as applicators. In addition, they were also supposed to apply grease to any pieces of special work in their territory. (SRDMR, October 1912, and Canadian Railway and Marine World, October 1915, p. 400) The grease was intended to reduce the friction between the wheels, curved sections of rail and special work. It was also thought that the grease would reduce the noise of the streetcar wheels as they negotiated curves. It was a common complaint that streetcar wheels frequently squealed when passing through tight curves. In winter, however, the track greasers could not apply the grease because of low temperatures and snow. During the winter months, therefore, the track greasers endeavoured to keep the special work clear of snow and ice with the aid of brooms, shovels and picks. (SRDMR, October-

December, 1912) Although the track greasers serviced the special work daily, the grease could not prevent the continual pounding of the streetcar wheels over the special work. After several years, the various parts of the special work either wore out or were pounded out of shape. New special work was then required.

All of the replacement special work was ordered through the Smiley Company. This was a local jobbing firm that carried the products of the Lorain Steel Company of the United States, and the products of Edgar Allen and Company of England. (CECR Nos.: 253, November 29, 1915; 121, June 5, 1916; 165, July 25, 1916) The three-part Y's were supplied by the Lorain Steel Company and the crossings were fabricated by Edgar Allen and Company. (Lorain Steel Company blueprints of materials supplied for the three-part Y's at 1st and 97th Streets, 1916, and Edgar Allen & Co. blueprint of crossing diamond, 1916) One may wonder if there were any Canadian manufacturers of special work and, if there were, why the ERR was purchasing special work from foreign countries. Although there were several Canadian manufacturers of special work, only one chose to submit a bid for Edmonton's 1916 special work requirements. (CECR No. 165, July 25, 1916) The bid was tendered by the jobbing firm of Gorman, Clancey and Grindley on behalf of the Canadian Ramapo Iron Works of Niagara Falls, Ontario. The cost of their special work was more than $300.00 higher than the price quoted by Lorain and Edgar Allen to fabricate the special work. (CECR No. 165, July 25, 1916) In addition, the Smiley Company guaranteed delivery of the special work before the beginning of October, while Gorman, Clancey and Grindley guaranteed delivery by December. In order for the ERR to replace the special work during 1916, it was necessary to have the special work available before the beginning of October. The higher cost combined with late delivery precluded the bid of the Canadian Ramapo Iron Works. The special work was ordered, therefore, from the Lorain Steel Company and Edgar Allen and Company, through the Smiley Company. (CECR No. 165, July 25, 1916)

Reconstruction, 1917

Towards the end of 1916, it was becoming apparent that heavy maintenance was required on some sections of permanent and temporary track constructed before 1913 if these sections were to remain in use. (CECR No. 43, February 13, 1917) Most of the permanent track that required repair consisted of lines constructed between 1907 and 1910. Part of the initial construction along Jasper Avenue, between 104th and 108 Streets, was in need of new pavement. It should be remembered that the original wood block pavement of 1907-1908 had been replaced by concrete and bitulithic pavement in 1910. After six years of heavy use, the bitulithic pavement was worn and in need of replacement. In addition, the bitulithic pavement along 101st Street as well as the paving bricks along 97th Street (formerly Namayo Avenue) were also in need of replacement. The wooden ties along 97th Street, between Jasper Avenue and the railroad tracks, had to be replaced because the spaces between the paving bricks had allowed water to accumulate around the ties, speeding their decay. (CECR No. 43, February 17, 1917) The first step required in the pavement reconstruction was the breaking up and the removal of the old pavement. When this had been done, track crews could effect any necessary repairs to the ties and to the rails. When all track repairs were complete, concrete was poured between the rails until the level was to a point ½ inch (12.7 mm) below the tops of the rail heads. Before it hardened, the surface of the concrete was shaped with templates so that flangeways were formed next to the rails. When the concrete had hardened, the reconstruction was considered complete.

Some sections of permanent track did not require new pavement but did require track work. Portions of track along 95th Street (formerly Kirkness Street), 118th (formerly Alberta) Avenue, and 82nd (also known as Whyte) Avenue required new rail joints. The standard angle bars used in the construction of these sections were becoming loose and were bending and breaking. The Superintendent of the ERR, J. H. Moir, recommended that the old angle bars be replaced with the continuous type of angle bar that was introduced in 1913. (CECR, May 7, 1917) To replace the angle bars, however, the pavement between the rails had to be removed and later replaced when the repair work was finished. In addition to the work already mentioned, several crossing diamonds were also replaced during 1917. (CECR No. 43, February 17, 1917)

Temporary track had also suffered from the effects of environment and time. Major repairs were required on the Highlands passenger line along 112th (formerly Knox) Avenue, between the East End (Borden) Park and 63rd (formerly Irwin) Street. Although the line was only five years old, many ties had rotted because of improper roadbed drainage and infrequent maintenance. In an attempt to prevent the line from becoming unserviceable, the ERR replaced most of the ties between the park and 63rd Street. (CECR No. 43, February 13, 1917)

Track Removal, 1917

The reconstruction of the temporary track on 112th Avenue provided the ERR with an opportunity to remove the spur on 62nd (formerly Grace) Street and the switch connecting it with 112th Avenue that had been constructed in 1912. (See Map 7 for location) It should be remembered that the spur had been built for the sole purpose of conveying building materials to the site of the Highlands School. The spur, therefore, had not been used since the completion of the building. The management of the ERR felt that the rails and ties of the spur could be removed and used in other locations since it seemed unlikely that anyone along that spur would require freight service in future. (Edmonton Journal, November 14, 1917, p. 2)

Track crews also removed the spur that ran from 95th Street (formerly Syndicate Avenue) along 109A Avenue (formerly Gallagher Street and north to 110th Avenue (formerly Wilson Street). This spur, which had been constructed to serve the needs of a sash and door manufacturer, no longer served any businesses and was, therefore, no longer required. (SRDGL, Account F16F) In addition, crews removed the spur on 118th (formerly Alberta) Avenue that had previously served the C. F. Taylor lumber yard. (SRDGL, Account C40)

Temporary Construction, 1918

In late 1917, it had been decided by the City Commissioners and by Superintendent Moir that a single-track should be constructed along 106th Avenue (formerly Sutherland Street) to connect the tracks on 101st Street with the tracks on 97th Street. This linkage was necessary to facilitate the new belt-line route system that had been introduced in October 1917. (CECR No. 205, November 27, and Canadian Railway and Marine World, November 1917, p. 446) In previous years, the ERR constructed lines according to the radial system of routing. In the radial system, tracks were constructed from a central point towards outlying areas. Streetcars would travel back and forth along these lines. The radial system is analogous to a spoked wheel. The hub would be equivalent to a central point, and the spokes would be equivalent to individual tracks radiating out in all directions from the central point, hence the name Edmonton Radial Railway. In the belt-line system of routing, streetcars still travelled to and from a central point. The distinguishing feature of the belt-line system was that the streetcars used tracks on one street to travel away from the central point, and used tracks on another street to return. (Harding & Ewing, 1926, pp. 257-270)

Construction of the single-track on 106th Avenue was started in April and was completed by the end of May. (SRDGL, Account C4PP, and SRDMR, April & May 1918) The track, which was 1,135 feet (346 m) long, connected the eastern track on 101st Street to the western track on 97th Street. (SRDMR, May 1918, and ERR drawing of track system, April 1920) With this arrangement, a streetcar travelling north on 101st Street could turn east onto 106th Avenue and then turn south on 97th Street, thus reversing its direction of travel. In addition to the 106th Avenue track, a Y was installed at the intersection of 112th (formerly Pine) Avenue and 78th (formerly Park) Street. (SRDGL, Account C4) The construction method used for 1918 temporary track was the type A construction introduced in 1913.

The location of the 1918 temporary construction may be seen on Map 11.

Temporary Construction, 1919-1920

In 1919, the ridership on the ERR increased for the first time since 1912. (Yorath, 1924, p. 45) The City Commissioners and Superintendent Moir planned two new extensions that were designed to further increase ridership. One extension was to be along 127th (formerly Brandon) Avenue. (Canadian Railway and Marine World, November 1919, p. 612) It should be remembered that the existing track on 127th Avenue was being leased from the EIR. The other extension planned was a double-track line along 78th (formerly Park) Street into the exhibition grounds. (Canadian Railway and Marine World, January 1920, p. 34) Construction was begun in October but neither extension was finished before the onset of excessive cold and snow in November. Superintendent Moir was asked to resign by the Mayor. This was done because the Mayor felt that the City was losing money not being able to transport people to and from the hockey games held at the exhibition grounds. The Mayor believed that it was because of Moir's inefficiency, not climatic conditions, that the extension to the exhibition grounds was not finished. (Edmonton Journal, January 5, 1920, p. 1) Moir eventually resigned, yet the extension could not be completed until spring. (Edmonton Journal, January 10, 1920, p. 6) The extension was 3,010 feet (917 m) long and consisted of a double-track line with a loop at its terminus in the exhibition grounds. The single-track extension along 127th Avenue went from 124th Street to 119th Street, a distance of 2,006 feet (611 m). (SRDMR, April 1920, and Canadian Railway and Marine World, January 1921, p. 36) This extension was designed to provide better service to the residents of Calder and to the workers at the GTP roundhouse. (Canadian Railway and Marine World, November 1919, p. 612) Both extensions were built using the type A method introduced in 1913.

The location of the temporary track extensions completed in 1920 may be seen on Map 11.

Track Removal and Repair, 1921

It has been mentioned in previous sections that some portions of track were rebuilt during the First World War in order to keep the lines in serviceable condition. Some track, however, was not rebuilt because of a lack of funds and low ridership on those lines. While some sections of track were in satisfactory shape, other sections required extensive rebuilding or the use of lighter streetcars. (Canadian Railway and Marine World, November 1921, p. 605) One section in particularly poor shape was the single temporary track along 76th Avenue (the McKernan's Lake line). Large single-end streetcars were frequently used on this line. Adequate ballasting, tie replacement and maintenance had not occurred since the line had been built. The result of this neglect was frequent derailments along the line. (SRDMR, January 1920 - October 1921) The McKernan's Lake line perpetually lost revenue and both the City Commissioners and the ERR management were reluctant to spend much money to improve the track. In an attempt to preclude expensive reconstruction, the ERR: replaced some of the older ties; removed the Y at the end of the line so that only lighter-weight double-end cars could use the track; and reduced the frequency of service on the line. (SRDAR, 1921, and Canadian Railway and Marine World, November 1921, p. 605) The trackwork was completed before the end of September, at which time streetcar service along the line was reduced to one car every half hour. (Current Flashes, October 1, 1921, pp. 4-5) The reduction in service, changes in routing and the use of double-end streetcars on certain routes, enabled the ERR to remove the Y at 95th Street and 106th Avenue which was in dire need of extensive repairs. (SRDAR, 1921)

The ERR also removed all the temporary single-track along 82nd Avenue west of 109th Street. This was done because the ERR had decided to close its south-side car barns in May 1921 in an attempt to reduce operating and maintenance costs. (CECR, December 1920) In addition, the freight spur that had been built to serve the Alsip Brick and Supply

Company was removed at this time. (SRDGL, Account C4Q)

Permanent Construction, 1922

New operating routes were planned by the ERR in 1921. One change was to have some routes originate and terminate near the intersection of 101st Street and Jasper Avenue. (Current Flashes, March 15, 1922, pp. 3-4) Without the aid of a crossover or a Y, it was impossible for streetcars to turn or to reverse direction on the double-track near 101st Street and Jasper Avenue. Since single-end streetcars were prevalent on the ERR, a unit of special work known as a combination Y and crossover had to be installed. It should be remembered that such a piece of special work had been installed on 124th (formerly 24th) Street at 105th (formerly Tretheway) Avenue in 1913. (CEAR, 1913, p. 287) The appearance of this combination Y and crossover may be seen on Map 8. The new special work was installed on 101st Street. The special work required a road or a lane for the "leg" of the Y. A lane located on the east side of 101st Street, north of 102nd Avenue, was selected as a suitable location for the leg of the Y. (Letter from the City Engineer to the City Commissioners, August 11, 1927) The lane was chosen because placing the Y on a heavily travelled street would create a hazard to motorists since the streetcars usually backed into the Y. The installation of the combination Y and crossover was not a simple operation. The pavement on 101st Street had to be broken and removed. A suitable concrete base for the special work was then constructed. When the base was complete, sections of the original track were cut and removed, then the special work could be installed and connected. The paving of the special work was the final step in the installation. The location of the combination Y and crossover installed on 101st Street maybe seen on Map 11.

Temporary Construction and Repair, 1922

A previous section mentioned that various portions of temporary track were not ballasted as often as required. One reason for this was that gravel was expensive and the ERR's deficit had been growing rapidly since 1916. (Yorath, 1924, p. 45) Something had to be done, however, to prevent the temporary track from becoming too dangerous to use. A possible alternative to gravel was found at the City Power Plant. The boilers at the power plant were heated by the burning of coal. The resulting ash and cinders had usually been discarded. The management of the ERR thought that since coal cinders were porous, hard, plentiful and inexpensive to obtain, they would make a suitable substitute for gravel ballast. The problem facing the ERR was how to get the cinders from the power plant, which was located on Ross Flats near the 105th Street Bridge (now Walterdale Bridge), to their lines. (Canadian Railway and Marine World, March 1922, p. 150)

Raw coal was shipped to the Power Plant by the EY&PR. This railroad crossed the ERR tracks on 97th (formerly Saskatchewan) Avenue, at 104th Street. (See Maps 8 and 11) The crossing was close to the City Power Plant. Permission was requested and received from the BRC, allowing the ERR to construct two switches and a short track that would connect the ERR to the EY&PR's power plant spur. (Canadian Railway and Marine World, March 1922, p. 150) The temporary track connection (interchange) enabled the EY&PR to push hopper cars loaded with ash and cinders onto the southern ERR track where they would be moved by ERR equipment. Conversely, when the hopper cars were empty, the ERR could return them to the EY&PR through the interchange. It should be noted that the BRC did not give the ERR permission to travel on the EY&PR tracks nor did the BRC allow the EY&PR to use ERR trackage. (Canadian Railway and Marine World, March 1922, p. 150) With the new interchange, the ERR could receive adequate supplies of ballast for the maintenance of their temporary track. The movement of freight on the ERR was still important.

Temporary Track Repair and Maintenance, 1922-1951

It was mentioned in the previous section that the ERR had not kept much of its temporary track in good repair because of high costs in obtaining gravel ballast. The construction of the interchange with the EY&PR in 1922, however, provided the ERR with a means by which to obtain an ample supply of coal cinders and ash. Cinders were an inexpensive substitute for gravel. Gravel ballast was, however, occasionally used. The repair of temporary track did not consist solely of reballasting. Poor drainage and soil conditions caused the rapid decay of many of the wooden crossties. Tie replacement was an annual maintenance activity. (SRDAR, 1925-1945, and ETSAR, 1946-1950). Standard-sized ties made from either fir or tamarack were used to replace rotten ties. Although new ties were generally used, the ERR occasionally used ties that had been salvaged from reconstructed sections of permanent track. (SRDAR, 1925, p. 5) Beginning in the 1930's, the ERR began to install tie plates on replacement ties. This was done because it was thought that the use of tie plates would prolong the useful lives of the ties, thereby reducing the need for tie replacement. (SRDAR, 1933) A minimal quantity of new rail was used in the repair of temporary track. When rails on temporary track broke or wore down to the point that they could no longer be used, they were replaced by rails either salvaged from abandoned lines, or by rails removed from permanent track during reconstruction. (SRDAR: 1925, p. 5; 1933; and SRDPTR, 1935)

The term "temporary track" was used to describe all unpaved street railway track that was constructed between 1908 and 1922, with the exception of the tracks on the High Level Bridge. While some sections of temporary track had been replaced by permanent track during that period, low ridership as well as economic conditions precluded most temporary track lines from being replaced by permanent track. (Yorath, 1924, p. 44) By the mid 1920's, it became apparent to the ERR that the term "temporary track" was no longer appropriate. City officials, including ERR management, began using two new terms to describe the unpaved track. The variously-used terms were "open track" and "skeleton track". (SRDAR, 1928-1945, and letter from the City Engineer to the City Commissioners, June 8, 1937)

The maintenance of open track did not include only tie, ballast and rail replacement. After several years of use, most rail heads required grinding in order to remove flanges of metal and corrugations (periodic gouging of the top of the rail head) caused by the repeated movement of streetcar wheels over the rails. (Harding & Ewing, 1926, pp. 281-283) Grinding of rails began in late 1937 when the ERR introduced its rail-grinding car. (SRDMR, November 1937, and ERR Plan of Rail Grinder Mechanism, 1937) A detailed description of the rail grinder may be found in a subsequent chapter. (Also see Appendix I)

Although new extensions of open track were constructed between 1926 and 1949, the maintenance and repair of these extensions was carried out using the methods described in this section.

Permanent Reconstruction, 1923-1927

Reconstruction and repair during this period, was undertaken only on those sections of permanent track in serious need of such work. The reconstruction ranged from the replacement of pavement to complete reconstruction starting from a new base. (SRDAR, 1924-1927) In 1925, for example, a section of double-track on 82nd (Whyte) Avenue between 100th Street and the CPR tracks was completely rebuilt. The original 1909 concrete base was broken up and removed. A new base, using the 1913 standard, was then constructed. (SRDAR, 1925, p. 5) The rest of the reconstruction basically followed the methods introduced in 1916. There were, however, several notable changes. The rail used in the 1925 reconstruction of 82nd Avenue was 60 pound per yard (24.9 kg/m) ASCE T-rail, instead of the previously-used 80 pound per yard (33.2 kg/m) ASCE T-rail. (CEED Drawing of Detail of Pavement at Rail, September 1923) As a consequence of using the smaller rail, the filler strip and wooden blocks placed against the outside edges of the rails were smaller. (See Figure 16) The filler strip used in this construction was a standard 1 inch by 2 inch (25.4 mm X 50.8 mm) board, painted with hot asphalt or mastic. The two wooden blocks were also smaller, being only 3 inches square (76.2 mm^2). The blocks were not supported by tapered concrete but by a 1 inch (25.4 mm) thick board that could have a width from 5 to 8 inches (127 mm to 203 mm). All wood surfaces were painted with asphalt or mastic. It should be noted, however, that the rail was not painted. Figure 17 (after CEED Drawing of Detail of Pavement at Rail, September 1923) shows the appearance, in cross-section, of track reconstructed according to the previously described method.

Some sections of permanent track did not require complete reconstruction. The rails along Jasper Avenue between 104th and 108th Streets

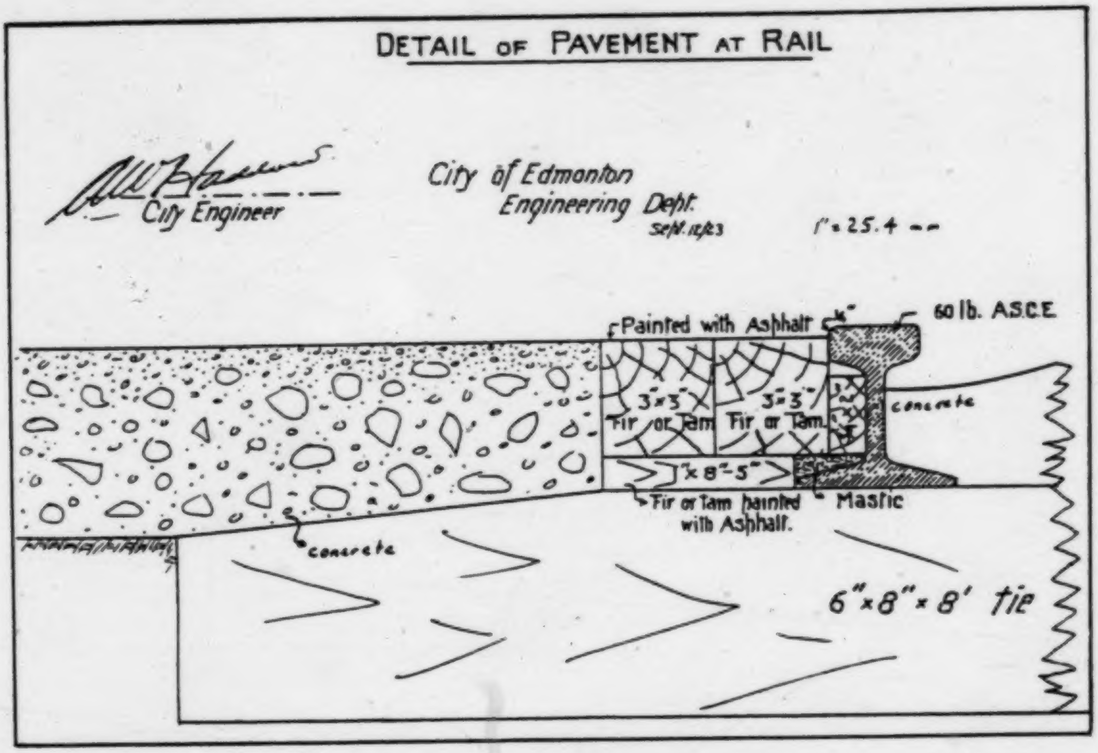

DETAIL OF PAVEMENT AT RAIL
City Engineer
City of Edmonton
Engineering Dept.
Sept. 11/23
1" = 25.4 mm
Painted with Asphalt
¼"
60 lb. A.S.C.E.
3"x3" Fir or Tam
3"x3" Fir or Tam
concrete
7"x 8"-5"
Fir or Tam painted with Asphalt.
Mastic
concrete
6"x8"x8' tie

FIGURE 17. PAVEMENT USED IN 1923-1927 RECONSTRUCTION

had become worn at the ends and this was interfering with the smooth and safe operation of the streetcars. In this instance, the only work required was the replacement of the rails and the pavement. This work was carried out during 1924 and 1925. (SRDAR, 1925, p. 5) Repairs were also made to special work. It had been mentioned in an earlier section that some special work had been replaced in 1916 and in 1917. Most of the special work that had been replaced was ten years old. By 1924, the majority of ERR permanent special work was ten years old and was showing signs of wear. The ERR and the City were unwilling to spend large sums of money to replace the special work. To prolong its usefulness, the ERR repaired the worn parts by arc welding. In this process, manganese steel welding rods were used to build up worn sections of the special work. (SRDAR, 1926, p. 2, and SRDGL, Account T)

The repair of special work and the reconstruction of portions of permanent track postponed the need for the reconstruction of large sections of permanent track. If the ERR intended to provide reliable and safe service in the future, however, major reconstruction of permanent track had to take place.

Permanent Construction, 1925

In 1924, the Canadian National Railways (CNR) and the City of Edmonton began the construction of a roadway underpass (sometimes referred to as a subway) on 101st Street between 104th and 105A Avenues. The purpose of the underpass was to allow the CNR tracks to cross over 101st Street without interfering with the movement of streetcars, road vehicles and pedestrians. Streetcar service on 101st Street was disrupted while the underpass was under construction. (Canadian Railway and Marine World, November 1925, p. 568)

By mid 1925, the construction of the tracks through the underpass could take place. Although the tracks were to be straight, the sub-grade dipped to provide clearance between the streetcars and the bridge carrying the railroad tracks. The standard concrete slab was used for the base. Standard-sized ties were also used. These ties, unlike the ties used in previous construction, were coated with either asphalt or creosote. (Provincial Archives of Alberta Photograph A. 2374) ASCE T-rail was not used. Although the track travelled in a straight line horizontally, it curved vertically. As a safety measure, therefore, grooved girder guard rails were used in the construction. The rails were manufactured by the Lorain Steel Company and carried the designation 98-451. This type of rail weighed 98 pounds per yard (40.6 kg/m). (Lorain catalogue 22, Tramway

Rails, 1927, p. 85) Figure 18 (after Lorain catalogue 22, Tramway Rails, 1927, p. 85) shows a cross-section through Lorain 98-451 rail. The height of the rail should be noted. The rails on 101st Street, approaching the underpass, were 80 pound per yard (33.2 kg/m) ASCE T-rails. Both the Lorain rail and the ASCE rail were 5 inches (127 mm) high. By using Lorain 98-451 rail, instead of the previously-used Lorain 108-398 rail, the ERR avoided the use of special compromise rail joints that were prone to breakage. Continuous rail joints, employing three track bolts per rail section, were used to connect the lengths of rail together.

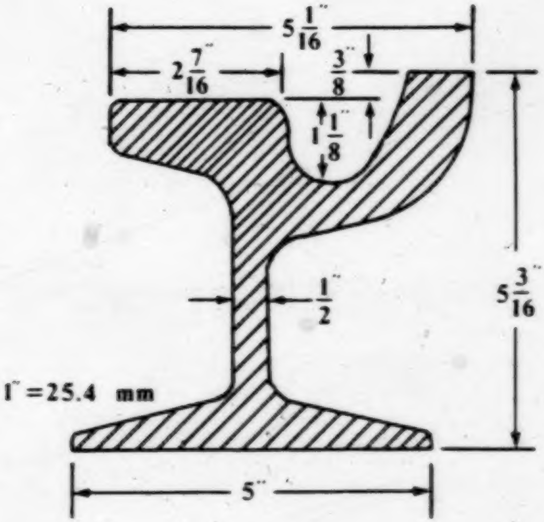


FIGURE 18. CROSS-SECTION OF 98-451 GUARD RAIL

After the ties and rail were in place, special drains were installed near and at the bottom of the underpass. These drains were designed to carry away any water that would flow into the underpass. To facilitate the draining of the rail flangeways, holes were burned through the sides of the guard lips, by workmen using oxy-acetylene cutting torches, at the locations of the drains. (Letter from ERR Superintendent W. J. Cunningham to City Commissioner D. Mitchell, June 6, 1929)

The paving method used was similar to that described in the section dealing with track reconstruction between 1923 and 1927. Special filler blocks were required because of the profile of the grooved girder guard rail. (CEED Drawing of Detail of Rail Filler for Lorain Section 98-451, March 1925) In addition, flangeways did not have to be formed in the concrete because the rails already provided flangeways. Plate 11 (Provincial Archives of Alberta) shows two stages of construction of the underpass tracks. The photograph was taken on July 14, 1925 from the bottom of the underpass. The photographer was facing north towards 105A Avenue. The left hand track had been constructed on the concrete base recently. Workmen are installing the wooden blocks along the edges of the right hand track in preparation for the final layer of concrete. The drain and the rail joints should be noted.

Track Removal, 1925

By 1925, most of the ERR's freight spurs were no longer in use. Some customers found that their supplies could be transported by other means, such as trucks, at lesser cost than the ERR. In addition, some customers had moved or had gone out of business. The new companies occupying the property either did not require the services of a freight spur or did not wish to use the street railway. (SRDAR, 1925, p. 5) A total of three freight spurs were removed: the spur into the City yards from 95th Street; the spur to the former premises of Robarts and Boon, also on 95th Street; and the spur to the Graves Lumber Yard, located on 118th Avenue. (SRDAR, 1925, p. 5)

ERR crews also removed the single temporary track along 106th

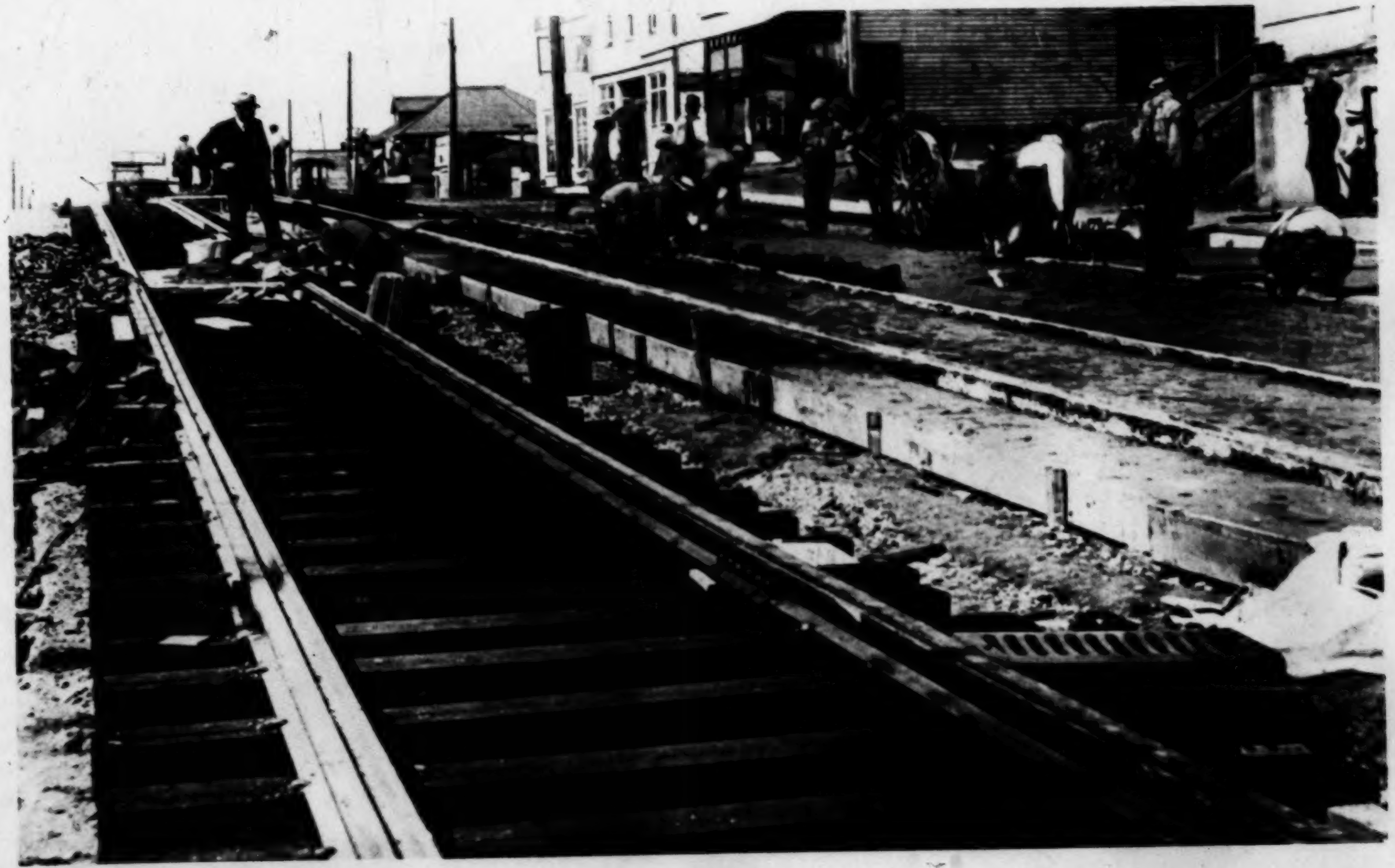


Plate 11. (Provincial Archives of Alberta) Track Construction Approaching 101st Street Subway, 1925

Avenue (formerly Sutherland Street) between 95th and 97th Streets. The track was removed because it had been out of service for several years. (SRDAR, 1925, p. 5) It should be noted that the special work located at 97th Street was not removed because to do so would have required the removal of pavement on 97th Street. This would have resulted in the disruption of service on that street. (SRDAR, 1925, p. 5)

Signal System, 1925

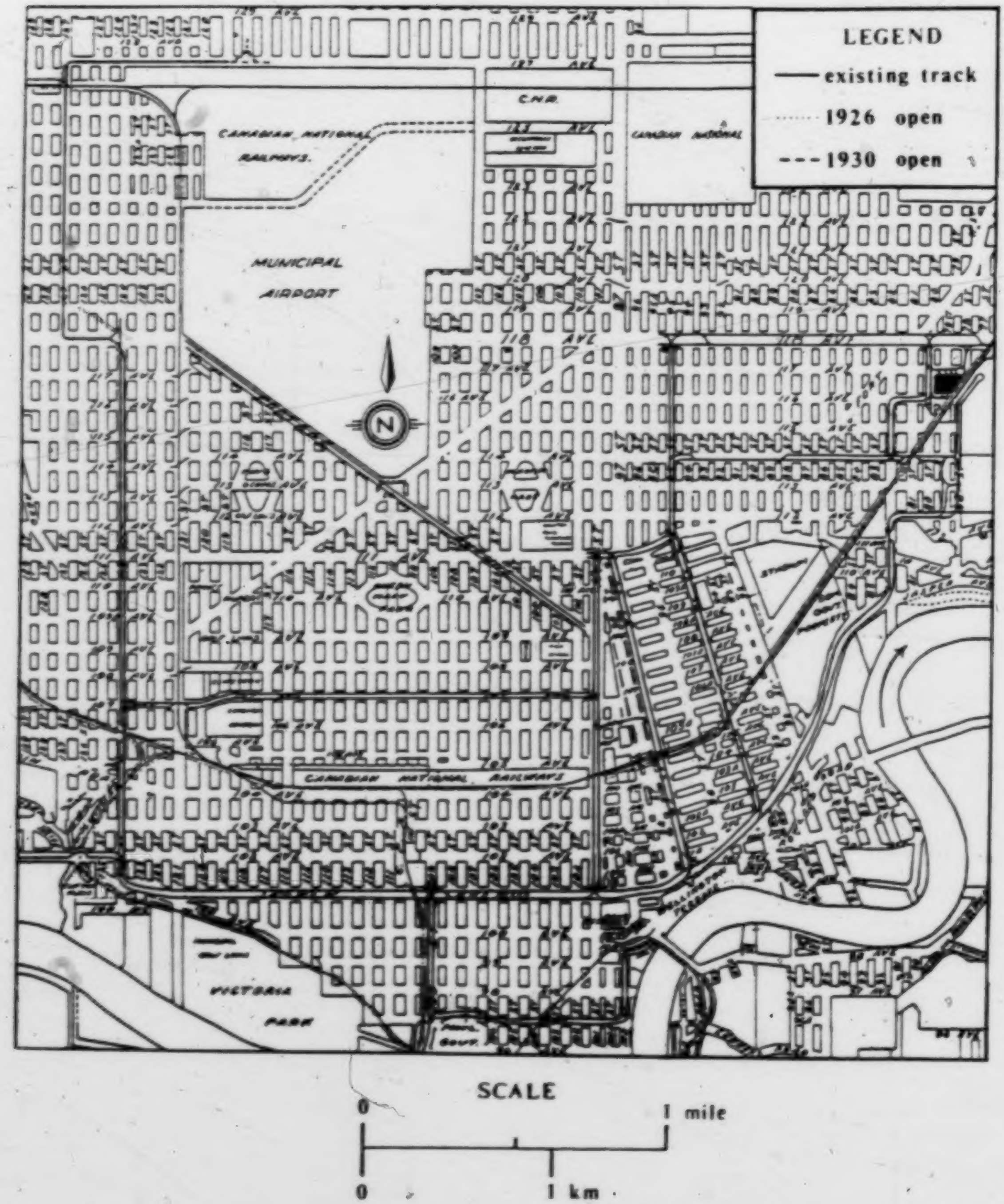
In 1923, the ERR and the CNR approached the BRC with a proposal to install an automatic signal system at the ERR/CNR crossing at 107th Avenue at 121st Street. The signal system was to consist of two colored light signals and an electric "wig-wag" road signal. (CNR Drawing of Proposed Automatic Flagman, October 1923) The BRC eventually gave its approval for the automatic signal system and it was installed during 1925. (SRDAR, 1925, p. 6) The operation of the signal system was similar to the operation of the block signal used on Strathcona (formerly Ross) Road during 1912. A streetcar approaching the CNR crossing from either side faced a signal that could display either a green or a red light. Both signals normally displayed a red light. As the streetcar approached, its trolley wheel would touch a contactor that would, if the railroad track was clear, cause the signal to display a green light. In addition, a circuit would be closed that provided power to a motor that would move the derails away from the rail heads. The streetcar could then proceed through the crossing. On the other side of the crossing, the streetcar's trolley wheel would touch another contactor that would reset the signals and the derails. If a train approached the crossing, its wheels closed a circuit in an insulated portion of the rail. This circuit locked the ERR signals on red, and activated the "wig-wag" road signal. A wig-wag consisted of a tall steel pole with a box mounted on the top. Another pole extended from the side of the box. This pole held a circular target with a red light in its centre. When the wig-wag was activated, the red light would turn on and the target would swing back and forth, hence the name wig-wag. Wig-wag signals were designed to warn pedestrians and motorists of the imminent approach of a train.

Open Track Construction, 1926

Although no new extensions to open track were contemplated, improvements to existing open track were a priority. The single-track line to Calder (127th Avenue), north of 118th Avenue, had no sidings. Only one streetcar at a time, therefore, could use this section of track. Since the ERR wished to increase the service on this line, a passing siding (turnout) had to be constructed to enable streetcars travelling in opposite directions on the line to pass each other. A siding was constructed on 127th Street from a point several yards (metres) north of 126A Avenue to a point several yards (metres) south of the right hand curve leading onto 127th Avenue. (SRDAR, 1926, pp. 2-3, and ERR drawing of 127th Street Track, North of 126th Avenue, March 1927) The siding may be seen on Map 12.

Open Track Removal, 1926

In an effort to reduce both maintenance and the risk of derailments, the ERR altered the arrangement of the special work at 80th Street and 116th Avenue which lead into the streetcar barns. Part of the special work was removed, so that only one track remained between the barns and 116th Street. Track crews also removed the track on 78th Street


LEGEND
existing track
1926 open
1930 open
CANADIAN NATIONAL RAILWAYS
C.N.R.
CANADIAN NATIONAL
MUNICIPAL AIRPORT
118 AVE
VICTORIA PARK
SCALE
0
1 mile
0
1 km

MAP 12. EXTENT & TYPE OF CONSTRUCTION
1926 – 1930

between the streetcar barns and 118th Avenue. (SRDAR, 1926, pp. 2-3)

Permanent Reconstruction, 1928-1936

The permanent track reconstruction of 1923 to 1927 had been undertaken only as a means to keep tracks in serviceable condition and to postpone the reconstruction of long sections. (SRDAR, 1926, p. 2) By early 1927, it was apparent to Superintendent Cunningham that the complete rebuilding of heavily-used sections of permanent track had to take place as soon as possible. Cunningham stated,

> We are endeavouring by means of minor replacement and welding where necessary to delay the time of track and rail replacements on a large scale. It will however, be necessary in the near future to entirely renew the rails in some of the heavy traffic sections. (SRDAR, 1926, p. 4)

Cunningham was able to persuade the City Commissioners and the City Council to approve extensive permanent track reconstruction plans by the end of 1927. The reconstruction was approved because of several factors. One significant factor was that most of the permanent track was actually in poor condition.

Several complaints had been received by the ERR and the City Commissioners about the poor track condition. (Correspondence between Superintendent Cunningham and the City Commissioners, May 1926-August 1927) In one instance, a resident complained of damage to his house from vibrations produced by the banging of streetcar wheels over a piece of special work adjacent to his house. This complaint was lodged after the Street Railway Department had repaired (by welding) worn parts of the special work. (Correspondence between the City Commissioners and Superintendent Cunningham, May 29 and June 2, 1926) Superintendent Cunningham further reported that the problem could not be resolved unless the existing pavement and special work were replaced. (Report to the City Commissioners from Superintendent Cunningham, June 2, 1926)

Another factor that encouraged the start of a permanent track reconstruction program was the large increase in ridership on the ERR during 1927. (CEAR, 1928, p. 23) Cunningham thought that improvements in operation might not only prevent a drop in ridership, but might also serve to further increase ridership. (CEAR, 1928, p. 22) In addition, the increasing revenues earned by the ERR in recent years had offset previously large yearly deficits. (SRDAR, 1926, p. 1)

The construction method used in the 1928 to 1936 reconstruction program was, essentially, the concrete slab method that was first introduced in 1913. The 1928 to 1936 construction method included several changes, however. The first step of reconstruction consisted of the removal of old track and the original concrete roadbed. The existing sub-grade was then tamped and rolled. A new base layer of concrete was then deposited and allowed to set in preparation for the placement of ties. Except for special work, standard-sized fir ties were placed on the hardened concrete, spaced 2 feet (0.61 m) centre to centre. Each tie was treated with creosote before being placed on the roadbed. (CEED Drawing of Street Railway Double Track Construction, February 1928) A new type of rail fastening device was introduced in 1928. In previous years, rails were fastened to the ties by track spikes which were pounded into the ties. If a rail required replacement, the spikes could be pulled out, a new rail installed and the spikes replaced. The replaced spikes did not, however, hold the rail firmly. In addition, the hammering required to drive the spikes into place frequently split the ties, rendering them useless. To alleviate these problems, screw spikes were used. Screw spikes were threaded fasteners which were designed to be turned, by means of a wrench, into holes drilled into the ties. The shoulder of a screw spike head was bevelled so that it could grip the base of the rail effectively. It was widely believed that screw spikes could facilitate rail replacement because this type of fastener could be removed and replaced several times without damaging the existing ties. Screw spikes, therefore, could hold rails firmly to the ties in a more effective manner than ordinary track spikes. The major disadvantage of screw spikes was their higher cost. (Harding & Ewing, 1926, p. 273) Figure 19 (after CEED Drawing of a Standard Screw Spike, December 1930) shows the basic appearance of the type of screw spike used by the ERR in permanent track from 1928. The metric conversion as well as minor deletions were made by the author.

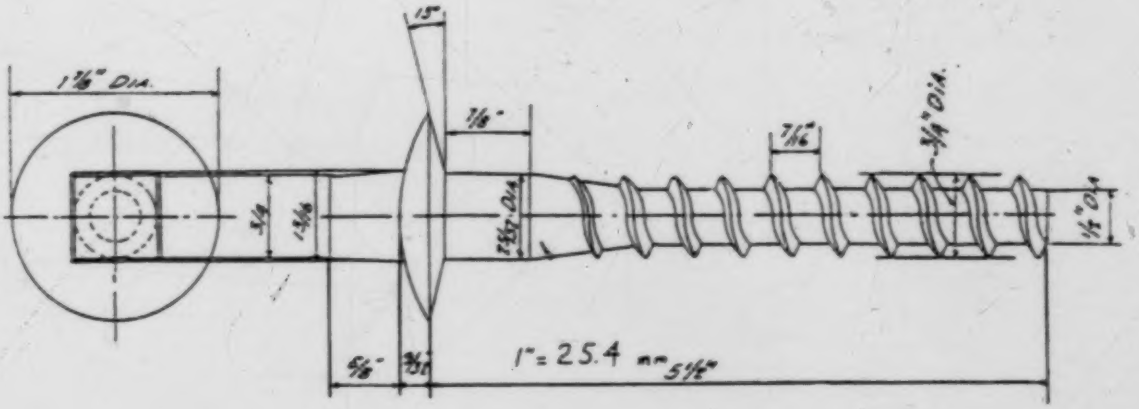


FIGURE 19. SCREW SPIKE

In addition to the use of screw spikes, the ERR began to use tie plates. (CEED Drawing of Street Railway Double Track Construction, February 1928) The tie plates, which were designed to prolong the life of the ties, rested on top of them and had two holes to accommodate screw spikes. The holes were placed so that they would match holes that had been drilled in the ties. It should be noted that the holes in the ties had been drilled before the ties had been placed on the roadbed. The holes in the ties were so placed that when the rails were secured to the ties, the rails would be aligned to the proper gauge. The rails were fastened to each tie by two screw spikes, one on each side of the rail. Figure 20 (after CEED Diagram Showing Tie Boring and Tie Plates, July 1934) shows a standard tie ready for installation. Minor alterations were done by the author. After the prepared ties and tie plates had been placed on the roadbed, lengths of rail were placed on top.

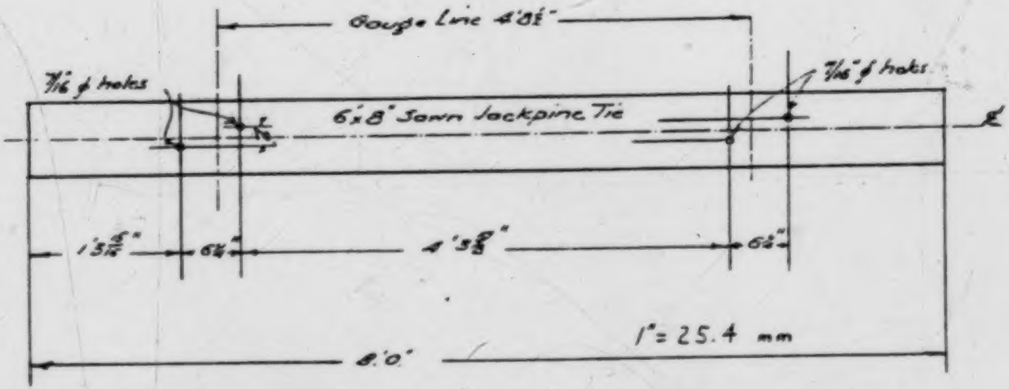


FIGURE 20. TIE BORING LAYOUT

Grooved girder rail was used instead of ASCE T-section rails. (CEED Drawings Showing Track Construction, 1928-1936) Although ordinary grooved girder rail was similar in appearance to grooved girder guard rail, the lip of plain grooved girder rail was designed to provide a flangeway only and was not intended to act as a wheel guard. The flangeways of grooved girder rail were also designed to enable snow and ice in the grooves to be forced out to the side by the passing of streetcar wheel flanges. (Cyclopedia of Applied Electricity, 1908, p. 84) This feature provided grooved girder rail with a distinct advantage over the previously-used ASCE T-rail and concrete flangeway that was not self-clearing.

Two brands of grooved girder rail were purchased between 1928 and 1936. The first, and most widely used brand, was type 103-287A, manufactured by the Bethlehem Steel Company of Bethlehem, Pennsylvania. The second brand was the Lorain Steel Company's type 103-478. (CEED Drawings of Track Construction, 1928-1936) Both rail types were identical in appearance and both weighed 103 pounds per yard (42.7 kg/m). It should be noted that in 1932 both rail types were modified slightly in order that they conform to standards set by the American Electric Railroad Engineers' Association. The modified rails had thicker bases so the total weight per yard was increased to 104 pounds (43 kg/m). (CEED Drawing of Rail Filler for Bethlehem and Lorain Grooved Girder Rails, March 1932) In spite of the change, several drawings prepared by the City Engineers after 1932 continued to refer to the rails by their former weight. Figure 21 (after CEED Drawing of Lorain 103-478 and Bethlehem 103-287A Rails, February 1929) shows the cross-sectional appearance of the two grooved girder rail types used by the ERR between 1928 and 1936. The height of the rails should be noted. Most of the reconstruction rebuilt sections of track in central Edmonton that had been constructed with high-T rail. Some of these sections were to be relaid with high-T rails. In addition, most of the special work rails were the same height as the high-T rail so the connecting grooved girder rail

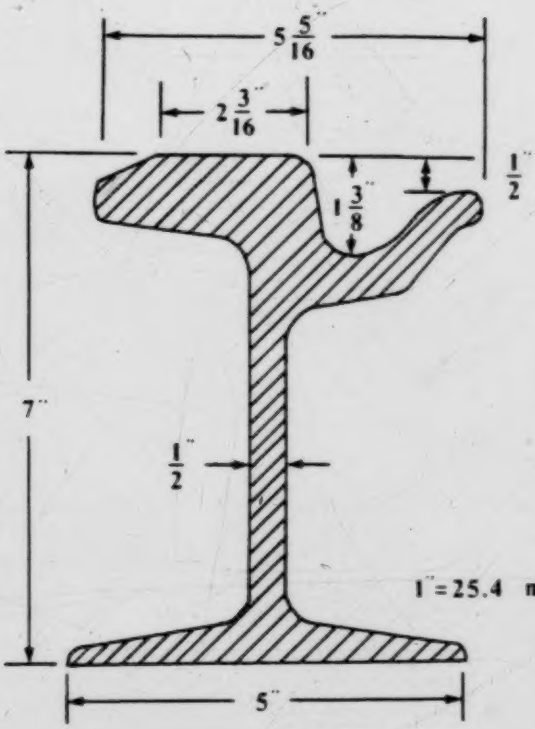


FIGURE 21. CROSS-SECTION OF 103-478 AND 103-287A GROOVED GIRDER RAILS

lengths should be the same height. Although there were compromise angle bars that could join shorter grooved girder rail to taller rail sections their use was discouraged because they allowed excessive vertical movement of the rails at the joints. Premature rail wear was the result of this vertical movement. (Harding & Ewing, 1926, pp. 280-281) The ERR also introduced a new method of fastening rail sections together. Various types of angle bars had been used since 1907 but each type had allowed considerable vertical movement between rail lengths. A type of "continuous" welded joint was used to overcome the problem of wear at the rail ends.

The "Thermit process" began with crews butting the ends of the rail lengths together and placing two halves of a mold box around the joint. The mold box surrounded both sides of the rail and the bottom, leaving the top exposed. The mold box was usually fabricated from steel and was filled with either casting sand or refractory material that had a cavity for the welding material. (Doane & Parkham, 1926, § 19 pp. 24-25) When the mold box had been secured to the rails with clamps, the mold cavity was filled from the top with a mixture of finely powdered iron oxide (Fe_2O_3) and aluminum. (Dover, 1929, p. 533) A thin strip of magnesium metal was then placed in the mixture and set on fire with an open flame. The heat of the burning magnesium caused an exothermic reaction to occur between the aluminum and the iron oxide. The resulting temperature, between 5,000° and 6,000°F (2 760°-3 316°C), was sufficient to melt the iron and the adjacent steel in the rails. This provided a uniform, rigid and complete bond between the two rail lengths. (Dover, pp. 533-534) Thermit welds were considered to be stronger than any electric or oxy-acetylene welded joint. (Correspondence between Superintendent Cunningham and the City Commissioners, June 1928-July 1929) Following the completion of the thermit welding, the rails were attached to the ties. It should be noted that angle bars and track bolts were used to join old sections of rail as well as special work to the new grooved girder rails. (CEED Drawings of Track Construction, 1928-1936)

A system of track drains was installed at this time. They were designed to remove water from the track area as well as from the rail flangeways. In order for the flangeways to drain, notches were burned into the rail lips with oxy-acetylene cutting torches at locations where there were track drain boxes (receptacles). (Letter from Superintendent Cunningham to Commissioner D. Mitchell, June 6, 1929) Following the completion of the trackwork, the area was paved, completing the reconstruction. Although the use of the 1923-1927 paving method was continued, the final surface of the pavement consisted of a 2 inch (51 mm) thick layer of asphalt instead of concrete. (CEED Drawing of Street Railway Double Track Construction, February 1928) Table 2 (after: SRDAR, 1928-1936; SRDPTR, 1934-1936; and CEED Drawings of Track Construction, 1928-1936) lists the year and the location of permanent track reconstruction between 1928 and 1936. No special work is included in this table.

Table 2 Reconstructed Permanent Track, 1928-1936

Year	Location
1928	*-97th Street, between Jasper and 103rd Avenues
	*-101st Street, between Jasper Avenue and lane north of 102nd Avenue (n.b. the Y at the lane was removed at this time)
* These sections were extensively repaired in 1929. (see text below)	
1929	-Jasper Avenue, between 101st and 104th Streets
1930	-Jasper Avenue, between 104th and 109th Streets
	-82nd Avenue, between CPR tracks and 105th Street
	-97th Street, between 103rd and 105A Avenues (this included a roadway underpass) (the special work at 97th Street and 106th Avenue was removed at this time)
1931	-Jasper Avenue, between 95th and 97th Streets
	-95th Street, between 111th and 114th Avenues
	-101st Street, between 105th and 107th Avenues
	-118th Avenue, between 88th and 95th Streets
	-124th Street, between 101st and 102nd Avenues
	-High Level Bridge (new ties and screw spikes only)

1932	-97th Street, between 108th and 111th Avenues -118th Avenue, between 80th and 88th Streets -Rat Creek (Kinnaird) Bridge (bridge deck only)
1933	None
1934	-95th Street, between 114th and 118th Avenues
1935	None
1936	-97th Street, between 105th and 108th Avenues

The winter of 1928-1929 revealed a serious problem with the track reconstruction of 1928. When the ambient temperature fell below -40° F (-40°C), the rails sheared apart where notches had been burned in the rail lips. The shearing was caused by the contraction of the rails at the low temperatures. Thermit joints, unlike angle bar joints, did not permit any longitudinal movement of the rail sections. In addition, cutting notches in the rails with a cutting torch had drawn the temper from the rails at those points. The stress caused by the low temperatures was, in most instances, sufficient to shear the rail where it had been weakened. (Letter from Superintendent Cunningham to City Commissioner Mitchell, June 6, 1929) In his letter of explanation to the City Commissioners, Superintendent Cunningham stated that the decision to adopt Thermit joints was made after careful consultation with other street railways located in cold climates that used the Thermit joint. Cunningham also stated that none of the street railways experienced such low temperatures as those in Edmonton. The Superintendent desired the continued use of the Thermit joint so a solution to the shearing problem had to be found. The sheared rails were repaired by crews electrically welding angle bars to the sides of the rails at the locations of the breaks. In future construction, holes were drilled (rather than notches cut) through the lips of the rails. (Letter from Superintendent Cunningham to Commissioner Mitchell, June 6, 1929) The modification appears to have worked since there were no further reports of sheared rails.

The permanent reconstruction of 1928-1936 also included several pieces of special work. In previous reconstructions, either new pieces were installed or the entire special work unit was replaced. This was not always done, however, between 1928 and 1936. In some instances, parts of the existing special work had not been used, while other parts had been worn out by heavy use. The grand union at 109th Street and Jasper Avenue is a good example of this. The northern parts had rarely been used, while most of the southern parts were in constant use. In such a case, the track crews dismantled the special work and replaced the worn sections with the unused parts of the special work, if this were possible. (CEED Drawings Showing Special Work Reconstruction, February 1928-July 1936) Table 3 (after: SRDAR, 1928-1936; correspondence between Superintendent Cunningham and the City Engineers, 1928-1936; and CEED Drawings Showing Special Work Reconstruction, 1928-1936) lists the year and the location of special work reconstruction between 1928 and 1936. The table also describes the appearance of the special work and describes whether the special work was rebuilt or replaced.

Table 3 Permanent Special Work Reconstruction, 1928-1936

Year	Type and Location	Work Done	Appearance
1928	-Three-part Y at 101st Street and Jasper Avenue	New parts on 101st Street only	Same
	-Three-part Y at 97th Street and Jasper Avenue	New parts, left-turn track on 97th Street removed	Modified
1929-1930	None		
1931	-Three-part Y at 101st Street and Jasper Avenue	New parts on Jasper Avenue only	Same
	-Three-part Y at 95th Street and Jasper Avenue	New unit, left-turn track on 95th Street omitted	Modified
	-Three-part Y at 95th Street and 111th Avenue	New unit	Same
	-Three-part Y at 95th Street and 118th Avenue	New unit, left-turn track on 95th Street omitted	Modified
	-Right Hand Branch-off at 95th Street and 114th Avenue	Used parts from 95th Street and 118th Avenue	Same
1932	-Grand Union at 109th Street and Jasper Avenue	Used parts from grand union; northern tracks removed as well as left-turn track on 109th Street	Modified resembled left hand branch-off
1933-1936	None		

Open Track Construction, 1930

The single-track line to Calder (127th Avenue) had been a stub line (a line without facilities for turning streetcars at its terminal) since the time it had been leased from the EIR in 1916 (see Map 11). Only double-end streetcars could use the line because of the lack of a Y or a loop at the terminus. Most of the ERR's streetcars had been converted to single-end operation by the mid 1920's so there were few double-end streetcars available. In addition, many of the single-end streetcars had a rear smoking area, a feature desired by many patrons of the Calder line. Although plans had been proposed as early as 1926 for the conversion of the Calder line to single-end operation, no action was taken until 1930. (Correspondence between Superintendent Cunningham and the City Commissioners, June 1926-August 1929) The City Commissioners and Superintendent Cunningham both decided that a Y was the least expensive means by which turning facilities could be provided. The Y was installed at 118th Street. (SRDAR, 1930, p. 3) In order for the single-end streetcars to be turned at the other terminus of the Calder route, a new Y was installed at the intersection of 95th Street and 106th Avenue. (Letter from Superintendent Cunningham to the City Commissioners, March 13, 1933) It should be remembered that there had been a Y at that location in the past but it had been removed in 1921. (SRDAR, 1921)

In an effort to improve streetcar operation along Strathcona Road, crews moved the passing siding that was located near the southern end of the Low Level Bridge. The siding was moved further south to a point adjacent to Connor's Road. (Canadian Railway and Marine World, September 1930, p. 592) The new location of the siding was thought to provide motormen with an unobstructed view of the entire single-track line on

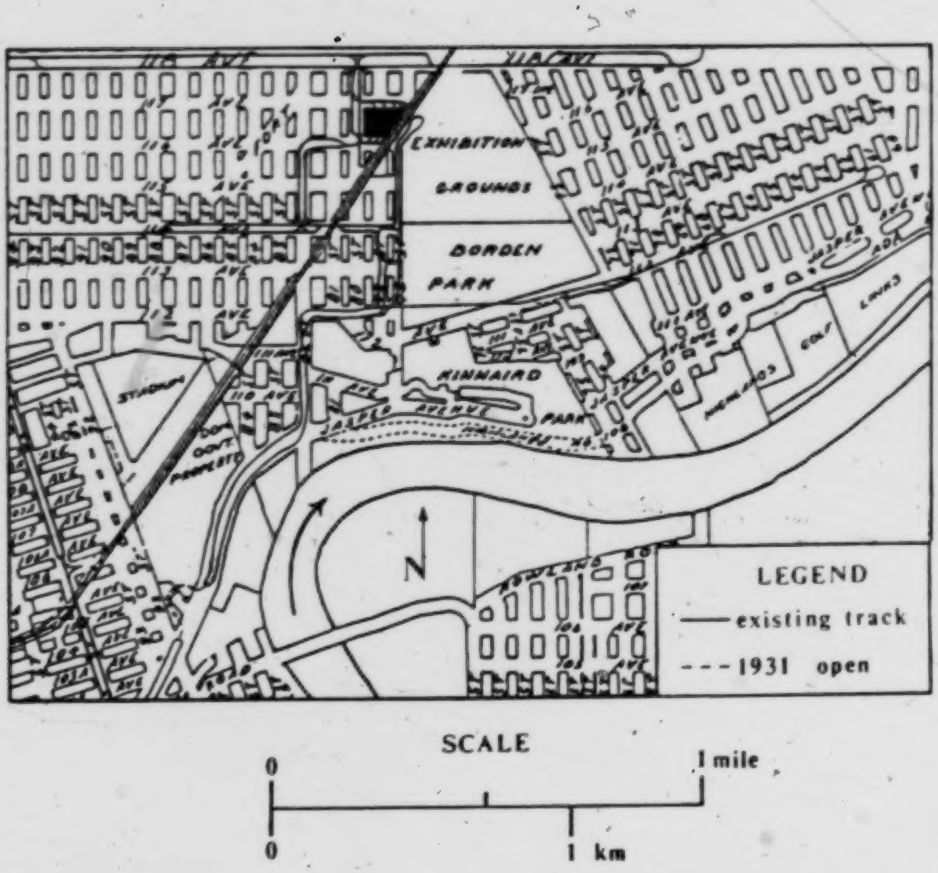
Strathcona Road.

The locations of the open track construction of 1930 may be seen on Map 12.

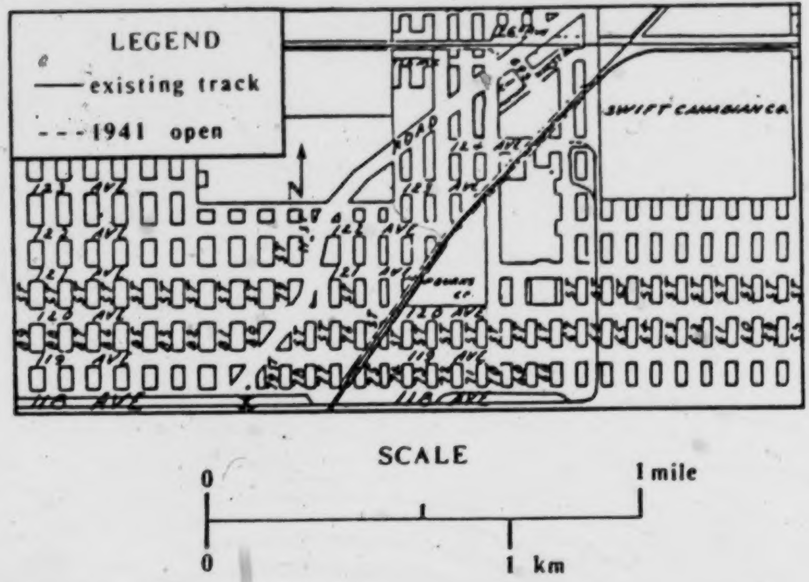
Open Track Construction, 1931

During the year, substantial reconstruction of the Highlands (112th Avenue) line between 78th and 62nd Streets took place. The reconstruction provided track crews with an opportunity to add additional passing sidings. (SRDAR, 1931, and Canadian Railway and Marine World, January 1931, p. 44) While the original siding at 68th Street remained, two new sidings were constructed. One was located near 75th Street and the other was located near 72nd Street. It should be noted that tie plates were used in the construction of these open track sidings. (CEED Drawing of Track System, 1936, and photograph by R. J. Walker, 1944) The locations of the sidings may be seen on Map 13.

Although the maintenance and construction of bridges was not the responsibility of the Street Railway Department, the safe operation of its streetcars was. The ERR management was concerned when the City Engineer stated that the condition of the trestle bridge over the Latta (formerly Penitentiary) Ravine (located on Jasper Avenue west of 92nd Street) had deteriorated to such an extent that streetcars could no longer use it. (Letter from City Engineer Haddow to the Elk's Club, October 10, 1931) The City Engineer did not wish to have the bridge replaced immediately. In addition, Superintendent Cunningham did not wish to have streetcar service disrupted along that portion of Jasper Avenue. Engineer Haddow proposed a "temporary" solution to the problem. He proposed to construct a diversion. The diversion was to start a few yards (metres) before either end of the bridge was reached. The track


118 AVE
118A AVE
EXHIBITION
GROUNDS
BORDEN
PARK
KINNAIRD
PARK
JASPER AVENUE
STADIUM
DOM GOVT PROPERTY
HIGHLANDS
GOLF
LINKS
ROWLAND RD
N
LEGEND
existing track
1931 open
SCALE
0
1 mile
0
1 km

MAP 13. NORTHEAST CONSTRUCTION, 1931


LEGEND
existing track
1941 open
N
SWIFT CANADIAN CO.
118 AVE
118A AVE
SCALE
0
1 mile
0
1 km

MAP 14. NORTHEAST CONSTRUCTION, 1941

was to travel north a sufficient distance to avoid the Latta Ravine entirely. After reaching the "head" of the Ravine, the track was to parallel Jasper Avenue for a short distance, through private property, and then turn south to join the track approaching the opposite end of the bridge. (CEED Drawing of Proposed Diversion, October 1931) Although the diversion was considered to be temporary, tie plates were used in the construction. (Photograph of Diversion by R. J. Walker, 1944) The diversion was completed and placed in operation in 1922. (SRDAR, 1932, p. 2) The completed diversion, which resembled a semi-ellipse, may be seen on Map 13. It should be noted that the so-called "temporary diversion" remained in use until that section of the track was abandoned in 1945, although a new bridge of steel construction was built in 1936. (Letter from Commissioner Mitchell to City Solicitor Garside, March 12, 1936, and photograph of the diversion by R. J. Walker, 1944)

Track Removal, 1932

For several years, Superintendent Cunningham had urged the City Council to authorize the abandonment of several unprofitable and under-used stub lines. As early as 1928, Cunningham had proposed that less expensive service to the areas served by the stub lines could be provided by replacing the streetcars with either trolley or motor buses. (Letter from Superintendent Cunningham to the City Commissioners, September 20, 1928) Although both types of buses required sound roadways, expensive track was unnecessary and was, therefore, eliminated. The City Council, as well as many citizens, repeatedly opposed Cunningham's proposals for the abandonment of street railway tracks. One stub line that Cunningham wished to abandon was the track on 102nd Avenue west of 124th Street. There were two bridges on the line and the one at

131st Street was in dire need of reconstruction. (Letter from Superintendent Cunningham to the City Commissioners, January 27, 1932) Cunningham had asked the City Council in December 1931 for authorization to purchase several motor buses, one of which was needed if service on 102nd Avenue was to continue while the bridge at 131st Street was being rebuilt. City Council eventually authorized the Street Railway Department to purchase the required motor buses. (Letter from the City Clerk to the City Commissioners, January 29, 1932)

The City Engineer had been insisting on the closure of the 131st Street bridge for some time since the bridge was in danger of collapsing. The bridge crossed a ravine that was both deep and long. It was, therefore, not possible to construct an inexpensive track diversion around the bridge. A motor bus replaced the streetcar service on 102nd Avenue on January 25, 1932. On the same day, the City Engineer closed the bridge at 131st Street, effectively preventing the reinstatement of streetcar service. (Letter from Superintendent Cunningham to the City Commissioners, January 27, 1932) The replacement bus service was deemed successful and the track on 102nd Avenue was removed later in the year. (SRDAR, 1933, p. 2) The introduction and use of a vehicle that did not require an expensive and fixed roadbed was to have detrimental effects upon the street railway and its development in the future.

Permanent Reconstruction, 1937-1943

Between 1933 and 1936, the amount of permanent track reconstructed was far less than the amount reconstructed between 1928 and 1932. (See Table 2) In the 1935 Street Railway Department Annual Report, written in June 1936, Acting Superintendent Ferrier warned City officials of the dangers of postponing further permanent track reconstruction, "I would like to point out that the permanent reconstruction of several sections of main line track must be faced very soon as the longer this construction is postponed the cost of maintenance will become higher and higher until it is prohibitive" (p. 2). Thomas Ferrier was appointed Acting Superintendent after the sudden death of Superintendent W. J. Cunningham on May 13, 1934. (Edmonton Journal, May 14, 1934, p. 1) The ERR obtained permission to have two sections of permanent track reconstructed. The tracks to be reconstructed were located on: 97th Street, between 108th and 111th Avenues; 111th Avenue, between 95th and 97th Streets. (CEED Drawing of Street Railway Double Track Construction, May 1937) Although the basic construction method used in 1937 was the same as the method used between 1928 and 1936, the 1937 reconstruction used shorter and heavier grooved girder rails. A major disadvantage of using tall rails was that unless paving blocks were used, large amounts of paving material were required to raise the level of the road to the tops of the rail heads. (Cyclopedia of Applied Electricity, Vol. III, pp. 84-85) In addition, rail corrugations seemed to be found more on tall rather than short grooved girder rails. (Harding & Ewing, 1926, pp. 282-283) The new type of grooved girder rail used was Bethlehem 105-418 which had a weight per yard of 105 pounds (43.6 kg/m). This rail, while being shorter than the grooved girder rails used previously, had both a wider head and base. The added width accounted for the greater weight of the new rail. (CEED Drawing of Street Railway Double Track Construction, 1937) Figure 22 (after CEED Drawing of Bethlehem 105-418 Rail, 1937) shows the appearance of Bethlehem 105-418 rail in cross-section.

The method of paving used between 1928 and 1936 was modified slightly in 1937. Instead of using wooden filler strips next to the rails,

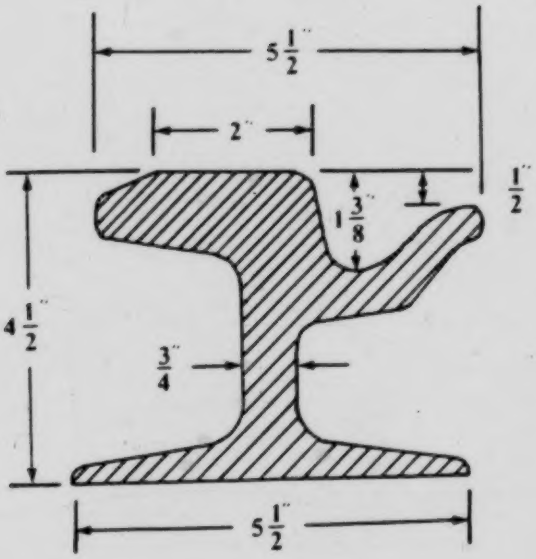


FIGURE 22. CROSS-SECTION OF BETHLEHEM 105-418 GROOVED GIRDER RAIL

fine concrete was poured around them. The concrete filler was also used around rebuilt special work rails. (CEED Drawing of Street Railway Track Construction, 1937) The use of concrete as a filler eliminated the problems experienced with the shaping, fitting and replacing of the wooden filler strips. It should be noted that the rest of the paving and construction methods and materials used in 1937 were identical to those used between 1928 and 1936. (CEED Drawings of Track Construction, 1937)

The year 1937 marked the end of extensive track reconstruction on the ERR. On December 22, the City Commissioners presented a report to the City Council that dealt with future developments of the street railway. The report stated that while some permanent reconstruction had taken place, almost two thirds of the permanent track had not been reconstructed. In addition, the report stated that the reconstruction already done had been the main cause of the exceedingly large capital deficit. (CECR, December 22, 1937, p. 2) The report recommended that consideration be given to the greater use of other types of vehicles, specifically motor and trolley buses. The report also recommended that further permanent track reconstruction be postponed until a rehabilitation program could be found that would not increase the capital debt of the ERR. (CECR, December 22, 1937, pp. 1-4) Additional support for the curtailment of reconstruction came in 1938. The report of a consulting firm recommended that no further reconstruction be done since another recommendation called for the eventual elimination of streetcar service. (Wilson & Bunnell, 1938, p. 1) The ERR adopted the report's recommendations, so track reconstruction plans were abandoned. In the 1938 Annual Report, Superintendent Ferrier stated, "One reason why no reconstruction work has been carried on this year is that the Department intends to convert certain routes from street car to electric trolley bus operation" (p. 9). Although no reconstruction of permanent track took place between 1938 and 1942, the three-part Y at 101st Street and Jasper Avenue was replaced, for the third and final time, during 1943. The special work was replaced because it had worn out and was beginning to interfere with the operation of the streetcars. (SRDAR, 1943, p. 2)

Apart from minor repairs and maintenance, no permanent track reconstruction took place between 1944 and the end of streetcar operations in September 1951. (SRDAR, 1944-1945, and ETSAR, 1946-1949)

Open Track Construction, 1939-1941

In 1938, the ERR and the City administration decided to introduce trolley buses (sometimes referred to as trolley coaches) on certain routes that were being served by streetcars. (CEAR, 1938, p. 9) Trolley buses, while not requiring an elaborate roadbed, did require paved roadways in order to operate efficiently. (*CEAR*, p. 9) The initial route proposed for trolley bus operation included crossing the Low Level Bridge. The bridge deck, as well as Strathcona Road, were both in dire need of reconstruction. (Wilson & Bunnell, 1938, p. 17) In 1939, following the recommendations of Wilson and Bunnell (1938), the ERR constructed an open track loop on 99th Avenue a short distance east of 100th Street. The construction of this loop ended streetcar service over the Low Level Bridge and enabled crews to repave the deck of the bridge in preparation for trolley bus service. (p. 18) Trolley buses were not the only reason, however, for new open track construction.

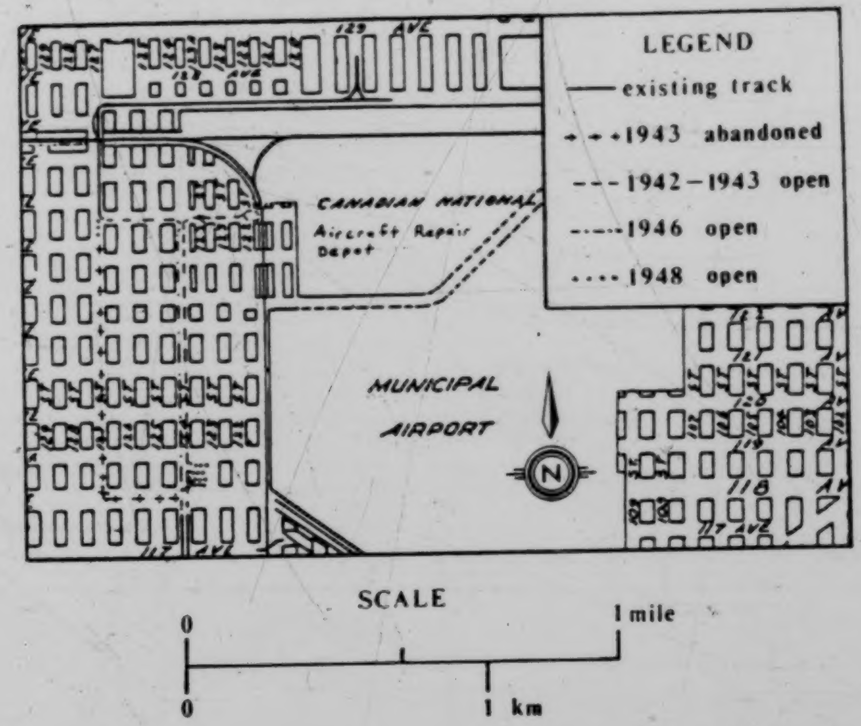
In October 1941, the ERR introduced library streetcar service to several outlying districts. (*SRDNMR*, October 1941, p. 1) This service, provided by a rebuilt passenger streetcar, required special parking sidings in order to avoid interference with other street railway traffic. Initially, the library streetcar visited the Calder and North Edmonton districts. (*Canadian Railway and Marine World*, November 1941, p. 623) To accommodate the library car at Calder, a short open track extension was constructed on the northern leg of the open track Y on 127th Avenue. (Provincial Archives of Alberta Photograph PA-454/1) For its visits to North Edmonton, a short open track stub-siding was constructed from the loop track located on 124th Avenue. (Palmer, Mitchell and Holcomb, 1950, p. 2) Map 14 (after Official Map of the City of Edmonton, 1938, and Palmer, Mitchell and Holcomb, 1950, p. 2) shows the location of the stub-siding for the library streetcar at North Edmonton. While the use of new vehicles brought about the construction of some open track, the effects of the Second World War would bring about substantial open track construction.

Open Track Construction, 1942-1943

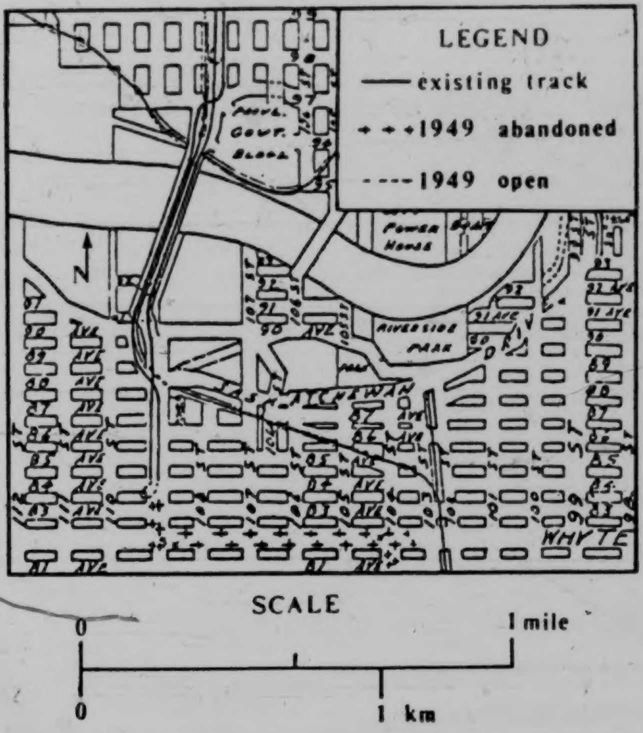
The Second World War, unlike the First World War, did not induce a drop in ERR ridership. The very opposite was true. Between 1940 and 1942, the ridership increased approximately 40%. (SRDAR, 1940-1943) The increase in ridership as well as wartime difficulties in obtaining buses effectively postponed the ERR's plans for the abandonment of streetcar service. There was also a demand for street railway service at the aircraft repair depot that was located on 125th Avenue near the railroad yards. (See Map 14) Although the depot was being served by motor buses, more workers at a time could be transported to and from the depot by streetcar. Several routes were proposed for the new streetcar line to the aircraft repair depot. One proposal advocated the use of the permanent double-track on Kingsway (formerly Portage) Avenue that had never been used. In another proposal, a single-track line of open track construction was to be built along 124th Street between 118th and 125th Avenues. At 125th Avenue, the track was to have a switch that would enable a streetcar to turn either east or west. The eastern track was to be built at a location near the aircraft repair depot where it would terminate in a loop. The western track was to connect with the existing single-track line on 127th Street (the Calder line). The proposal also called for the removal of the existing track on 127th Street between 125th and 118th Avenues (part of the old EIR). (CEED Map of Proposed Street Railway Extensions, July 1942) The Dominion Transit Controller, a Federal wartime position, gave approval to the latter proposal and construction began in the fall of 1942. (SRDAR, 1942, pp. 1-2 and Edmonton Bulletin, November 7, 1942) The trackage to the area of the aircraft repair depot was completed by the end of February 1943. (Edmonton Bulletin, February 22, 1943) Although the methods and the materials used in this open track construction were unchanged from those used in previous years, the season in which construction took place was changed. In the past, most track construction terminated when cold temperatures and snow arrived. The halt in the construction of the line to the exhibition grounds during the winter of 1919 is an example of this practice. (Edmonton Journal, January 5, 1920, p. 1; see also a previous section, Temporary Construction, 1919-1920) The construction of the new line to the aircraft repair depot proved that open track construction could continue during the winter months if absolutely necessary. In March 1943, following the completion of the new track, ERR crews removed the old, and now unused, track from 124th Street. (Edmonton Bulletin, March 23, 1943) Map 15 (after Official Map of the City of Edmonton, 1938, and CEED Map of Proposed Street Railway Extensions, July 1942) shows the location of the open track construction of 1942-1943.

Open Track Construction, 1946

The population of Edmonton, as well as ridership on the ERR, increased greatly after the end of the Second World War. In addition, during 1946 the names Edmonton Radial Railway and Street Railway Department were replaced by the name Edmonton Transportation System (ETS), which reflected the street railway's increasing use of buses. (ETSAR, 1946, p. 1) The final elimination of streetcar service was delayed, however, by the increase in ridership and because of difficulties in obtaining enough buses to replace the streetcars. One streetcar line that could not readily be replaced by buses and which required more frequent service was the single-track line to Calder. In order to increase service and in order to avoid the problems associated with passing sidings, the ETS constructed a second open track along 124th Street which paralleled the


129 AVE
127 AVE
CANADIAN NATIONAL
Aircraft Repair Depot
MUNICIPAL
AIRPORT
N
118 AV
117 AVE
117 AVE
LEGEND
existing track
1943 abandoned
1942–1943 open
1946 open
1948 open
SCALE
0
1 mile
0
1 km

MAP 15. NORTHWEST CONSTRUCTION, 1942–1948


PROVL. GOVT. BLOCK
POWER HOUSE
N
RIVERSIDE PARK
SASKATCHEWAN
90 AVE
WHYTE
81 AVE
LEGEND
existing track
1949 abandoned
1949 open
SCALE
0
1 mile
0
1 km

MAP 16. CENTRAL CONSTRUCTION, 1949

single open track constructed during 1942 and 1943. Construction commenced at 118th Avenue and proceeded north to a point several feet (metres) south of the switch at 125th Avenue where it connected with the other track. Unlike the construction of 1942-1943, the 1946 construction was carried out during the spring and summer months. (ETSAR, p. 1) The location of the track constructed in 1946 may be seen on Map 15.

Open Track Construction, 1948

By 1948, the conversion to bus operation and the consequent street railway track abandonments were causing noticeable effects on street railway operations. One new trolley bus line, for instance, was to travel north along 124th Street to a loop at 118th Avenue. Part of the program to prepare trolley bus routes consisted of paving the streets that the trolley buses would use as well as the removal of any open construction streetcar tracks on those roads. It was planned, therefore, to remove the existing streetcar tracks on 124th Street between 107th and 118th Avenues and then to pave 124th Street in preparation for trolley bus service. (CECR No. 15, April 26, 1948, p. 1, and CEED Minutes of 1948 Paving Program Meeting, January 14, pp. 1-2) The removal of the tracks on 124th Street south of 118th Avenue meant that the tracks to Calder (north of 118th Avenue), which were still in use, would be isolated from the rest of the street railway system. The operation of the Calder section, while considered to be temporary, required the construction of storage and service tracks since the nine streetcars assigned to that section could not return to the streetcar barns. A set of four spur tracks, one of which doubled as a Y, were constructed on a lot located on the east side of 124th Street immediately north of 118th Avenue. (CECR

No. 15, April 26, 1948, p. 1)

One of the streetcars assigned to the Calder section was the library streetcar. (CECR No. 15, p. 1) Before the isolation of the Calder line, that streetcar had also served North Edmonton. In order for the library streetcar to provide better service to the people along the Calder section, a new stub-siding was constructed south from 125th Avenue along 127th Street. (Palmer, Mitchell & Holcomb, 1950, p. 2) The location of the Calder storage and service tracks as well as the library streetcar stub-siding may be seen on Map 15.

Open Track Construction, 1949

After the Second World War, the number of private automobiles in use in Edmonton increased greatly. (Wilson, 1949, pp. 1-10) In his report to the City on his assessment of the ETS (referred to as the Edmonton Transit System since 1947), Wilson stated that the turning of streetcars at 104th Street and 82nd Avenue by means of the three-part Y was a dangerous practice because there was heavy automobile traffic at that intersection. (p. 21) Wilson recommended that an open track loop be constructed on a lot located on the east side of 109th Street north of 82nd Avenue. (p. 21) While the City followed Wilson's basic recommendation, the loop was constructed on the east side of 109th Street immediately south of 84th Avenue. (CECR No. 2, March 28, 1949, p. 2) The Wilson Report of 1949 also recommended a streetcar route change. The change included the termination of one route at the north end of the High Level Bridge. To enable streetcars to turn near this location, Wilson recommended, and the City crews constructed, an open track loop at 98th Avenue between 109th Street and the CPR tracks. (Wilson, 1949, p. 2) These two open track loops, which may be seen on Map 16, were the last sections of street railway track to be constructed for the ETS. Street railway service ended in the early morning of September 2, 1951 and the construction and the maintenance of street railway track was no longer a concern to the ETS. In the following months, various City crews removed the remaining sections of open and permanent track, with the exception of several large pieces of permanent special work. In subsequent years, as the pavement covering them wore away, portions of these pieces of special work were visible once again. (Author's Observations and Photographs)

Chapter IV

Electric Power Production and Distribution, 1908-1981

Introduction

In Chapter II, it was stated that as early as 1893, some fourteen years before construction began on a municipally-owned street railway system in Edmonton, a Territorial Ordinance specified that electrically powered vehicles could be used on a municipally-constructed street railway in Edmonton. (Ordinances of the North-West Territories, 1893, No. 32, p. 279) Later, in 1904, the Town of Edmonton agreed to allow a private company to attempt the construction and operation of a street railway in the Town. The Agreement specified that the streetcars were to be powered by electricity which was to be distributed by a system of overhead wires. The Agreement, furthermore, stipulated that the electricity was to be returned to the electrical generator through "suitable conductors", such as the rails. (Memorandum of Agreement [Revised], between the Town of Edmonton and the Edmonton Street Railway Company, 1904, pp. 5-7; see Chapter II for further information about the Ordinance of 1893 and the history of the Edmonton Street Railway Company) By 1907, when the City of Edmonton started the construction of a municipally-owned street railway, most other street railways in North America were powered by electricity. (Burch, 1911, pp. 2-11) The predominance of electrically powered street railways, as well as the fact that Edmonton's power plant was owned by the City, were decisive factors in the selection of electricity as the source of power for Edmonton's street railway. (CEAR, 1908, p. 93)

The development of street railway electricity production in Edmonton can be divided into three overlapping periods, mechanical generation, electrical rectification, and electronic rectification. The first of these periods, mechanical generation, refers to the production of street railway Direct Current (D.C.) by means of mechanical devices such as engine driven generators and generators driven by Alternating Current (A.C.) and D.C. motors. This period spanned the years 1908 to 1951. The second period, electrical rectification, began in 1929 and continued until the time of this research. "Electrical rectification" refers to the use of electrical devices, specifically mercury-arc rectifiers, to convert (rectify) A.C. into D.C. for use with streetcars and trolley buses. The third period, electronic rectification, began during the mid 1970's and was in use when this study was completed. The term "electronic rectification" refers to the use of high capacity solid state components (usually diodes) to rectify supplied A.C. into a D.C. suitable for use by trolley buses and by Light Rail Transit (LRT) vehicles. Although the periods of electricity production for use by vehicles of the ERR/ET overlap, a development from one type of D.C. production to another is easily discernible.

Mechanical Production, 1908-1910

When the City of Edmonton began the construction of the street railway in 1907, consideration was given to the type, size and numbers of generating equipments that might be required for the street railway. The most common voltages that were used on urban street railways in North America ranged between 550 and 600 volts D.C. The precise voltage was usually determined by the type of distribution system used. (Doane & Parkham, 1926, § 17 pp. 6-9) In addition, the most common form of power generation was by a D.C. generator driven by some form of reciprocating engine. (Cyclopedia of Applied Electricity, Vol. III, pp. 1-

5) Several manufacturers produced D.C. generators, each brand being similar in construction and operation. There were, however, many types of reciprocating engines that could be used to drive the generator. Early in 1907, the City Commissioners realized that the power plant in operation at that time, which was being operated with steam power, was being used to its capacity. The plant would have to be augmented in order for it to be able to supply the new street railway with electricity. (CECR No. 64, April 2, 1907, p. 1) In order to use additional steam engines to power the needed generators, an additional boiler would have to be obtained. In addition, in order to house the new boiler and steam engine, a new building would have to be erected. The City Commissioners, in an attempt to keep costs as low as possible, investigated alternate types of reciprocating engines. One type of engine that was widely used at that time was a large internal combustion engine that used a type of coal gas known as "producer gas". (CECR No. 64, April 2, 1907, pp. 2-6) The producer gas for the engine usually came from a gas producer and its gas storage reservoir which were located near the engine. A gas producer was a device that enabled hydrogen and carbon monoxide gases to be driven from a quantity of coking coal through a roasting process. Hydrogen gas and carbon monoxide gas were the main constituents of the producer gas. (Electric Railway Journal, May 14, 1910, p. 862) The main advantages of using a producer plant and gas engine over the traditional water boiler and steam engine were that the producer installation required less space and was thought to be more efficient. (CECR No. 64, April 2, 1907, pp. 2-6) One of the major disadvantages of producer gas engines was that they were not as powerful as steam engines of comparable size. This disadvantage, coupled with a long required delivery time, prompted the City Engineer and the City Commis-

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sioners to purchase a producer gas engine and plant for uses other than those for the street railway. (CECR No. 64, April 2, 1907) The City Commissioners had anticipated that the new producer gas plant and engine would free a steam engine in the power plant that could be connected to the street railway generator. (CECR No. 105, December 17, 1908, p. 1)

In August 1908, when it became apparent that the street railway would be ready for operation before the end of the year, the City purchased one 300 kW, 550 volt D.C. generator from the Westinghouse Company. (CECR No. 15, February 1909) A 300 kW generator was purchased because it was thought to have a capacity in excess of what would be initially required by the street railway. (CECR No. 105, December 17, 1908, p. 1) The Westinghouse generator arrived by the middle of October. (Edmonton Journal, October 16, 1908, p. 1) The generator could not, however, be connected directly to a steam engine. The producer gas plant had not been completed by this time. All the power plant steam engines were needed to provide the necessary electrical power to the City. To overcome the shortage of steam engines and as a temporary measure, the street railway generator was arranged in the power house so that it would be driven by a steam engine through the use of a flat leather belt. The belt was placed over the flywheel of the steam engine to a pulley that was mounted on the shaft of the generator. As the flywheel rotated, the belt caused the shaft of the electrical generator to rotate. Since the flywheel had a larger diameter than the diameter of the generator pulley, the generator shaft rotated through more revolutions. While this arrangement enabled the generator to create some electrical power, its maximum output could not be achieved. The power that was needed by the generator to produce its maximum output would have been sufficient to cause either one of two things to happen. The belt would slip or it would break, thereby disrupting service on the street railway. (CECR No. 105, December 17, 1908, p. 1) The single 300 kW generator had the potential for generating more power than what was required. It was not sufficient, though, to power the entire street railway.

All electrical conductors used in the street railway power distribution system, including the trolley wires and the rails, offered resistance to the flow of electricity. (Cyclopedia of Applied Electricity, Vol. III, pp. 92-94, and Dover, 1929, pp. 616-617) As a streetcar travelled away from the generator, the voltage in the trolley wire dropped. If a streetcar travelled several miles (km) away and no supplementary power was fed into the trolley wire, the voltage drop in the trolley wire would be sufficient to reduce the streetcar's speed and power noticeably. If the distance travelled was great enough, the voltage drop would be so great that the streetcar would not be able to move itself. The loss of electrical power in the distribution system, or line loss as it is commonly referred to, is more pronounced with D.C. than with A.C. (Doane & Parkham, 1926, § 17 p. 18) Line loss in D.C. circuits could be compensated for in several ways.

One way was to connect a copper cable with a much larger diameter than the trolley wire to the generator and run the cable to distant points along the trolley wire. On heavily-used lines, the cables were usually placed on poles that were placed alongside the streetcar line. The larger cable, being made of solid copper bar or stranded copper wire and having a greater area than the trolley wire, would offer less resistance to the flow of electricity. Less resistance also meant that there would be less line loss. The voltage in the larger cable, if measured half a mile

(0.8 km) away from the generator or further, would be higher than the voltage measured in the trolley wire at that point. The large cable, called a "feeder", was connected to the smaller trolley wire at frequent intervals by short lengths of copper wire. In this manner, the feeder would feed or boost the voltage in the trolley wire. The voltage of the trolley wire would, therefore, be kept as close to the generated voltage as possible. (Dover, 1929, pp. 618-624) In order for feeders to be fully effective, however, the rails, which provided the return path for the electricity used by the streetcars, had to be connected to other feeder cables, usually placed underground, which travelled from the rails to the generator. (Dover, pp. 618-624) Feeders used by themselves were ineffective and were uneconomical. A feeder's effectiveness was limited by distance. Although feeder cables were usually larger than trolley wires, they were subject to line loss like any other conductor. After a distance of approximately 2 miles (3.2 km), the voltage in the feeder would have dropped by such an extent that the trolley wire voltage would not be increased beyond that point. If the streetcar line continued for several more miles (km), power from another generator, usually located in a substation near the end of the line, would be required to prevent the trolley voltage from dropping too low, thus adversely affecting the operation of streetcars in that area. (Dover, pp. 618-624)

The use of substation generators in conjunction with feeders overcame the distance limitation that was inherent with feeders. Substations were usually placed at locations beyond the point where the feeders from the power house generator had any benefit. (Dover, pp. 628-630) Prior to the 1930's, all street railway substation generating equipment in Edmonton consisted of devices known as "motor generators". (Report to the City Commissioners from Power Superintendent W. J. Cunningham, November

22, 1928, pp. 1-2)

A "motor generator" consisted of a D.C. generator and an A.C. motor mounted on a common steel or cast iron frame. The shafts of the two units were coupled at one end. When the motor was energized, its shaft rotated. Because of the coupling of the two shafts, the shaft of the generator also rotated, thereby producing D.C. electricity. The output voltage of the generator was controlled by the speed of the motor in conjunction with a rheostat (a large variable resistor) that controlled the intensity (strength of the electromagnetic field) of the generator's field coils. (Harding & Ewing, 1926, p. 147) If, for example, the generator's output voltage was too high, a reduction of the voltage going through the generator's field coils would reduce the efficiency of the generator, thereby reducing its output voltage. If, however, the speed of the motor decreased to one-half its normal speed, for instance, the output voltage of the generator would fall to such a low level that adjustments to the setting of the rheostat would not raise the generator's output voltage to the acceptable level (550 to 600 volts D.C.). In order for a motor generator to maintain a steady output voltage, its performance had to be monitored by an operator located in the substation. By monitoring a voltmeter connected to the generator, the substation operator could either increase or decrease the strength of the generator's field coils by adjusting the rheostat as the numbers of streetcars using the track increased or decreased. This was done to maintain the voltage of the generator between 550 and 600 volts. (Harding & Ewing, p. 147)

The extension of the street railway tracks into Strathcona (located on the south side of the North Saskatchewan River) starting in August 1908 meant that the track located along Whyte (82nd) Avenue was beyond the effective range of the feeders from the power plant. (See Map 3 for locations) In order to prevent the streetcars from encountering power shortages at that location, the City purchased a 250 kW motor generator from the Canadian General Electric Company and placed it in a building located at Walter's Mill. (CEAR, 1908, p. 93, 1909, p. 105, and 1911, p. 133) Walter's Saw Mill was located on the riverbank in Edmonton near the power plant. (Mundy's Street Index Map to Edmonton, 1912) The motor generator was located close enough to the Strathcona track for its feeder to be effective. The feeder was connected to the Strathcona trolley wire at the intersection of Main (104th) Street and Whyte (82nd) Avenue. (ERR Drawing of Feeders and Track, 1912)

The protection of the generating equipment from the effects of short circuits and lightning was an essential consideration. A direct short circuit between the trolley wire and the rails would cause the maximum amount of current to flow through the circuit. This excessive current flow could seriously damage the commutator and armature of a generator if there was no circuit breaker present. A circuit breaker was placed in series between the positive terminal or bus bar of the generator and the trolley wire. Another circuit breaker was usually placed in series between the rail feeders and the negative terminal or bus bar of the generator. The circuit breaker would protect the entire circuit, including the generator, from damage. When excessive amounts of current were drawn in an extremely short time, a strong magnetic field would develop around a heavy coil inside the circuit breaker. This magnetic field would act as a solenoid and would pull an iron bar that was connected to a latch which held a moveable contact in place. When the latch was released, strong springs would force the moveable contact to open quickly, thus breaking the circuit. Before streetcar service could be resumed, the moveable contact had to be closed by hand and the latch reset. The reclosing of a circuit breaker usually took place after the cause of the excessive current draw had been determined and corrected. (Doane & Parkham, 1926, § 17 pp. 7-9) Lightning, if it was allowed to reach the generator, could destroy the windings and the commutator. In addition, the varnish used to insulate the windings could be set on fire. To protect generating equipment from lightning, devices known as lightning arresters were connected in parallel between the ground and both the positive and negative feeder lines leaving the generating station. When lightning struck a trolley wire, a current surge usually travelled through the wire. As the surge approached the generating station, it would encounter a lightning arrester. One end of the arrester was connected to the feeder or to the trolley wire, and the other end was connected to the ground. An air gap or a dielectric within the lightning arrester prevented current from flowing through the arrester normally. The high current surge of a lightning strike would, however, tend to travel through the lightning arrester to ground, as the arrester provided a shorter path to ground than through the generating equipment. It should be noted that while most lightning surges were arrested entirely, some lightning strikes close to the generating equipment could be powerful enough to enable some of the surge to reach the generating equipment. (Harding & Ewing, 1926, pp. 150-157)

The ERR experienced power shortages and failures despite the system's 550 kW D.C. capacity. The producer gas plant and engine that had started working in November 1908 suffered from frequent shut-downs because of operational problems and required maintenance. (CECR No. 12, February 2, 1909) The producer engine was connected to a 50 kW, 120 volt D.C. generator which provided power to operate the pump motors for the City water supply. (CECR Nos.: 8, 1909, and 3, January 8, 1916)

When water demand was heavy or when the producer plant was shut down, power for the water pumps had to come from additional generators that were connected to the power plant steam engines. One of these steam engines was also connected to the 300 kW street railway generator. (CECR No. 105, December 17, 1908) The steam engine was not large enough to provide full power to both generators attached to it so when there was a high demand for electricity from the generator for the water pump motors, the speed of the steam engine dropped, resulting in a consequent drop in voltage of the street railway generator. Any drop in the speed of the steam engine meant that there would be a proportional drop in the speed of the street railway generator since that unit was connected to the steam engine's flywheel by a belt. Several press reports noted that streetcar service was frequently reduced, curtailed or interrupted by the failure of the gas producer and its engine. (Edmonton Journal, November 13, 1908, p. 1, November 21, 1908, p. 1, and December 14, 1908, p. 1) The situation was further compounded in December when the City Council and the Commissioners authorized the ERR to purchase more streetcars. No additional generating equipment was ordered until after the ERR received approval to purchase additional rolling stock. (CECR No. 105, December 17, 1908) The delay in ordering more generating equipment was to prove detrimental to the efficient operation of the ERR. Apart from observing the problems encountered with the generating system then in use, the City Commissioners had known since the beginning of November that the ERR was planning to double the number of streetcars in its fleet. The Superintendent of the ERR, C. E. Taylor, in the 1908 Annual Report which covered the period from December 1, 1907 to October 31, 1908, stated, "The indications are that the present passenger equipment will have to be doubled in the next few months while express, baggage and freight cars are also likely to be added shortly" (p. 81).

The City Commissioners were of the opinion that steam engines were preferable to producer gas engines for any type of electrical production in view of the poor service, high cost and the perpetual maintenance of the producer plant and engine owned by the City. (CECR No. 12, January 26, 1909) After due consideration of the submitted proposals, the City Commissioners and the City Council authorized the purchase of two steam engines that would be used only for street railway power generation. One engine was ordered from the Belliss and Morcom Company of Birmingham, England and the other was ordered from the Robb Engineering Company of Amherst, Nova Scotia. Each engine was rated at 550 HP (410 kW) and both were of the vertical compound variety. (CECR Nos.: 105, December 17, 1908; 12, January 26, 1909) With a vertical steam engine, the cylinders were mounted vertically. The pistons, therefore, would also travel vertically. This arrangement meant that the crankshaft and the flywheel would be mounted on a horizontal plane. The term "compound" meant that the engine had two cylinders of different diameters and that steam, after passing through the first cylinder, was exhausted into the second cylinder before it was exhausted into a condenser for recycling. In the operation of a compound engine, steam from the boiler would enter the first of the two cylinders, which was the smallest. When the piston had travelled through one stroke either up or down, the steam would be exhausted into the second cylinder which was larger in diameter, thus compensating for the reduction of steam pressure. In this manner, the steam was used twice before it was recycled. (Air Brake Compressors, 1924, § 1 p. 40) The two steam engines required steam pressure of 165 lbs. per square inch (1 138 kPa) in order to operate at maximum power. (Letter from Power Department Superintendent W. J. Cunningham to the City Commissioners, June 13, 1925)

By March 1909, the City Council and the Commissioners had approved the purchase of two generators that were to be connected to the steam engines. (Contract for two street railway generators with the Crocker-Wheeler Company, March 12, 1909) Two 400 kW, 575 volt D.C. generators were ordered from the Crocker-Wheeler Company. That company was selected because its cost for the generators undercut the nearest competitive bid by over $2,000.00 (CECR No. 13, February 1909) None of the new street railway generating equipment could be used, however, until the power plant was enlarged and the boiler capacity increased. This building and the equipment installation were not complete by the end of 1909. (CEAR, 1909, pp. 103-104)

Faced with an incomplete plant, additional streetcars being placed in service on the ERR and the continual failure of the gas producer plant and engine, the City purchased an additional 125 kW motor generator in 1909 which was installed at the power plant to supplement the output of the belted 300 kW generator. (CEAR, p. 103) In addition to those problems, the ERR ordered several more streetcars for delivery in 1910. (CEAR, p. 97) The electrical power shortages that the ERR had experienced in the past would continue. It should be noted that at this time the power generating equipment was purchased and operated by the Power Plant Department. (CEAR, pp. 104-105)

The steam engines and the two Crocker-Wheeler generators ordered in 1909 were placed in operation during 1910. In order for these two generators to generate 550 to 575 volts, the steam engines had to rotate the generators' shafts at the rate of 350 rpm. (PDAR, 1927) In addition to this installation, the original 300 kW Westinghouse generator that had been belted to a steam engine flywheel, was directly coupled to a Robb Engineering Company 400 H.P. (298.4 kW) vertical compound steam engine that had been in use at the power plant for several years. This engine was made available by the installation of additional A.C. production equipment in the power plant. (CEAR, 1909, p. 104, and 1912, p. 196) The new generating equipment provided enough power for the ERR to operate all its streetcars within a determined radius of the power plant. In the 1910 Annual Report, the Superintendent of the Power Plant Department, P. McNaughton stated, "I believe that we have at present sufficient D.C. machinery to supply all demands of the Street Railway within the efficient transmitting radius for 550 volts. This radius may be said to be through Strathcona and north in Edmonton to the Norwood Boulevard [111th Avenue]" (p. 117). (See Map 4 for the location of the ERR tracks at this time) McNaughton also stated that the ERR would have to erect substations in northern Edmonton if it wished to extend its lines and wished to be able to increase the frequency of streetcars in areas outside the power plant's radius. (CEAR, p. 117) In anticipation of the ERR installing a motor generator at some distant point, McNaughton ordered additional A.C. producing equipment so that there would be adequate power for any new generating apparatus purchased by the ERR. (CEAR, pp. 117-118)

Power Distribution, 1908-1910

Before electric streetcars could operate on the track laid for them, some form of electrical distribution system had to be in place. Edmonton chose to use, as its means of supplying electricity to its streetcars, an aerially suspended bare wire that was located at a specific and constant height over the centre of the track. The tracks were to form the return portion of the circuit. This type of distribution system was known as a "ground return" system. (Doane & Parkham, 1926, § 17 p. 3) It was mentioned in the previous section that D.C. was to be used. One characteristic of D.C. is that it has a constant direction of movement or polarity (positive and negative). At the time Edmonton's street railway was being constructed, the theory that electricity was the movement of electrons through a circuit from the negative terminal to the positive terminal of a power source was vaguely understood. The theory widely believed in at that time stated that in a circuit, current (the flow of electricity) passed from the positive end of the power supply to the negative end. (Cyclopedia of Applied Electricity, Vol. III, 1908) In the interest of clarity, the so-called "current-flow" theory will be followed unless otherwise stated.

The installation of the track usually took place before the installation of the overhead wires. (See Chapter III for descriptions of track construction methods) During the track construction before the pavement was constructed, consideration was given to the use of devices that would improve the conductivity of the rails. In Chapter I the hazards of electrolysis (the leakage of current from the rails through the ground and its consequent damage to buried metal fixtures and objects) were described. A voltage difference between the individual rails in a track was a major cause of electrolysis. To reduce the possibility of a voltage difference, heavy copper cables called cross-bonds were welded (bonded) to the base of each rail. Cross-bonds were installed at approximately 500 foot (152 m) intervals. In addition, if there was double-track construction, the two tracks were cross-bonded at intervals between the individual rail cross-bonds. (Doane & Parkham, 1926 § 19 p. 32) In addition to the use of cross-bonds, rail bonds were used by most street railways.

Rail bonds were short lengths of copper cable that were welded to the sides of the rail heads around each rail joint. The purpose of rail bonds was to provide a good current path around the rail joints, thereby reducing the likelihood of current leaking into the ground. (Doane & Parkham, § 19 p. 26) It appears that Edmonton installed cross-bonds on the earliest permanent construction of 1907-1908. Rail bonds do not appear to have been used. Plate 2 (Provincial Archives of Alberta) shows a section of permanent track under construction on Jasper Avenue in 1907. The labelled cross-bond should be noted as well as the absence of any rail bonds. It also appears that no bonds of any sort were used on temporary track (see Plate 6). The lack of rail bonds and the lack of bonds on temporary track not only increased voltage loss in the rails but allowed electrolysis to occur. Although the effects of electrolysis were not immediately apparent, it would cause the ERR perpetual problems in subsequent years. Following the completion of track construction, the overhead electrical wires could be installed.

The first trolley wires for use on Edmonton's street railway were made from solid copper bar that was drawn cold through steel dies so that it became grooved on two sides. Grooved trolley wire was available in several sizes. Edmonton selected the most common size in use, Brown and Sharpe gauge 2/0. (Letter from Eugene Phillips Electrical Works to the Edmonton Secretary-Treasurer, November 1, 1909) The trolley wire was grooved so that it could be securely gripped and supported by special clamps called "ears". (Doane & Parkham, 1926, § 18 p. 14, and Ohio Brass Catalog No. 23, 1940) Although round trolley wire was used in other installations and was available, its use was unpopular because the ears required for round wire had to extend around the sides of the wire. The added surface of the ears was usually sufficient so that they were frequently struck by the passing streetcar trolley wheels (current collector). Over a prolonged period, the ears would be destroyed by this action, necessitating costly repairs to the overhead assembly. Grooved trolley wire, however, offered a completely smooth surface for the trolley wheels. (Doane & Parkham, 1926, § 18 p. 14) Before the trolley wire could be installed, segmented tubular steel poles or wood poles had to be placed along the route of the streetcar tracks at regular intervals. In addition, the poles had to provide some sort of support that was arranged perpendicular to the track in order that the trolley wire would be held in the correct position at the right height. The type of poles to be used and their placement was the first step in the construction of the street railway overhead. Edmonton used both segmented tubular steel poles as well as wood poles and employed three main types of trolley wire suspension: span-wire construction; centre-pole construction; and side-bracket construction. Span-wire construction consisted of a series of two poles placed at both sides of the road directly opposite each other. A braided steel wire called a "span wire" was strung across the road and was attached to each pole at a predetermined height above the surface of the road (see Plate 6). Centre-pole construction, which could be used only along straight sections of double-track, consisted of a series of single poles placed between the two tracks. Attached to these poles were steel tubes arranged so that they projected over each track and mounted on the poles (at a specified height above the tracks) so that they were parallel to the ground. The tubes were supported by truss rods and tubular angle braces. Each of these tubes had two steel castings attached to it. One casting was affixed to the end of the tube while the other was attached several inches (mm) away from the first casting. A short length of span wire was then attached to each casting (see Plate

12). Side-bracket construction consisted of a series of single poles placed along one side of a single or double track. A steel tube (bracket) was then attached to the poles in similar manner as in centre-pole construction. Steel castings and a length of span wire was also attached to the tube (see Plate 7). (Doane & Parkham, 1926, § 18 pp. 15-18) Besides knowing what type of pole and suspension methods to use, installing crews had to know how far apart each pole (or poles, in the case of span-wire construction) was to be. In the initial construction, the standard distance between poles was 100 feet (30.5 m), except in areas of curves or special track work where the distance between poles ranged from 89 feet to 117 feet (27 m to 35.7 m). (ERR Drawing Showing Position of Poles, 1908) The distance between poles was considered sufficient to support the trolley wire adequately without excessive lateral movement of the trolley wire. Pole length ranged from 30 feet to 32 feet (9.1 m to 9.75 m). For each pole, a 6 foot (1.8 m) deep hole was bored into the ground with hand powered augers. (ERR Drawing Showing Position of Poles, 1908) Crews, using ropes, horses and long, thin spiked poles (sometimes called "pikes"), would raise each pole and place it in the hole. The steel poles were held in place with concrete while the wood poles were usually held in place with tamped earth. When the poles were in place, crews could then install the span wires and/or bracket assemblies. In the case of centre-pole or side-bracket construction, commercially manufactured bracket assemblies (tubes, castings and braces) were used. (ERR Drawing of Trolley Poles and Brackets for Proposed Edmonton-Strathcona [High Level] Bridge, November 1911) Where span-wire construction was used, 5/16 inch (8 mm) diameter stranded galvanized steel wire was attached to the poles so that the centre of the wire was 16 feet (4.9 m) above the centre of the road. When centre-pole or side-bracket construction was used, the brackets were placed on the poles so that the small length of span wire was 20 feet (6.1 m) above the centre of the track. The heights of the respective suspensions were within commonly accepted street railway standards. (ERR Drawing Showing Position of Poles, 1908, and Doane & Parkham, 1926, § 18 pp. 15-18) Following the completion of the pole and suspension installation, crews could begin the task of installing the trolley wire.

In the initial construction, one end of a spool of trolley wire was attached to a pole at one end of the line. The spool, mounted on a push cart, was wheeled along the track. As the trolley wire unreeled, crews with the aid of a wooden tower temporarily fastened it to the span wires with short lengths of small wire. It should be noted that the trolley wire was "dead" (not connected to any power source) at this time. (Doane & Parkham, 1926, § 18, p. 18) Plate 12 (City of Edmonton Archives) shows a crew stringing wire along the south track on Jasper Avenue at 100th Street in the summer of 1908. The steel centre-pole construction, wooden tower, push carts and the spool of trolley wire should all be noted. The installation of the trolley wire was far from complete. In order to prevent an extreme electrical hazard and in order to minimize line loss, the trolley wire had to be insulated from the span wire. This was accomplished by the use of "hangers". Hangers were galvanized malleable iron castings that were designed to be attached to the span wire. The middle of the hanger casting contained a stud (threaded rod) or a bolt that projected a short distance from the bottom of the casting. The remainder of the stud was surrounded by a rigid insulating material, usually porcelain. The stud and the insulation were held in place by a cap screwed onto the top of the casting. (Doane & Parkham, 1926, § 18 p. 23) The hanger stud was designed to hold an

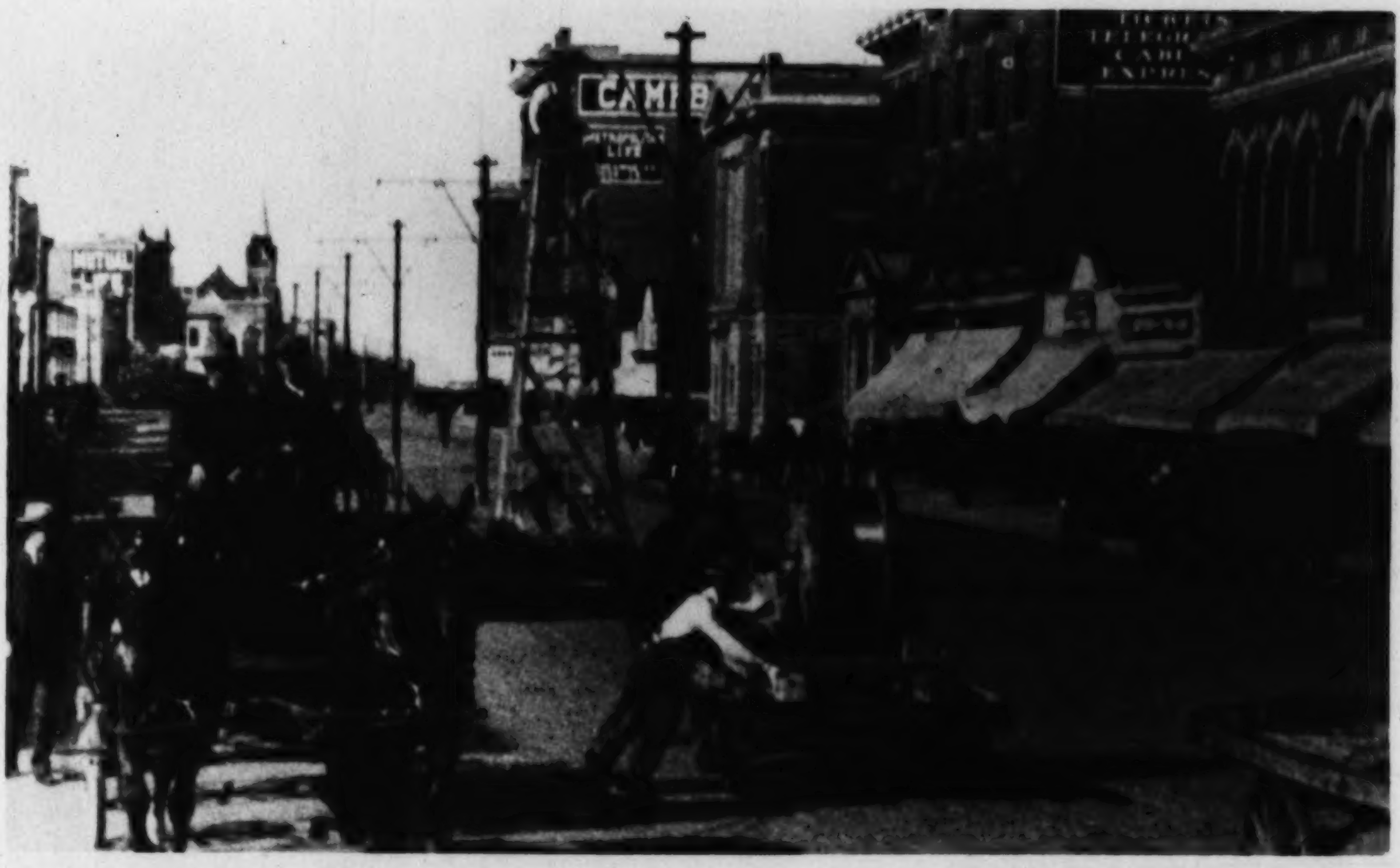


Plate 12. (City of Edmonton Archives) Installing Wire Above Jasper Avenue, 1908

ear that would subsequently be attached to the trolley wire. Trolley ears, which were briefly explained earlier in this section, were castings that were designed to be screwed onto hanger studs and were also designed to be attached to the trolley wire. Trolley ears were usually cast of phosphor bronze or brass because these alloys resisted corrosion and wear and were also much stronger than ordinary copper. (Doane & Parkham, 1926, § 18 p. 24) There were two basic types of ears used, the plain ear and the feeder ear. The plain ear simply held the trolley wire to the hanger. The feeder ear possessed a lug that enabled a copper cable attached to the feeder to be connected to the ear. In this manner, feeder voltage reached the trolley wire. (Doane & Parkham, 1926, § 18 pp. 24-25) After the ears were installed on the hangers, the trolley wire was tightened with winches so that it did not sag. The ears were attached to the trolley wire by clinching (bending) the edges of the ear into the grooves of the trolley wire. Clinching was facilitated by the use of hammers and specially shaped steel anvil blocks known as "clinch blocks" which enabled hammer blows to be transmitted from the clinch block to the edges of the ear without damage occurring to the softer trolley wire. (Ohio Brass Catatlog No. 23, 1940, p. 108) Figure 22 (after Doane & Parkham, 1926, § 18 pp. 23-25, and Ohio Brass Catalog No. 23, 1940) shows the typical appearance of a completed hanger, ear and 2/0 grooved trolley wire installation. The hanger depicted is a representation of an Ohio Brass Company type D straight line hanger. Although other brands of overhead materials were used, the products of the Ohio Brass Company of Mansfield, Ohio were most frequently used. (Letter from Canadian General Electric Co., Canadian importer of Ohio Brass products, to C. E. Taylor, ERR Superintendent, September 8, 1909, and artifacts in the author's collection)

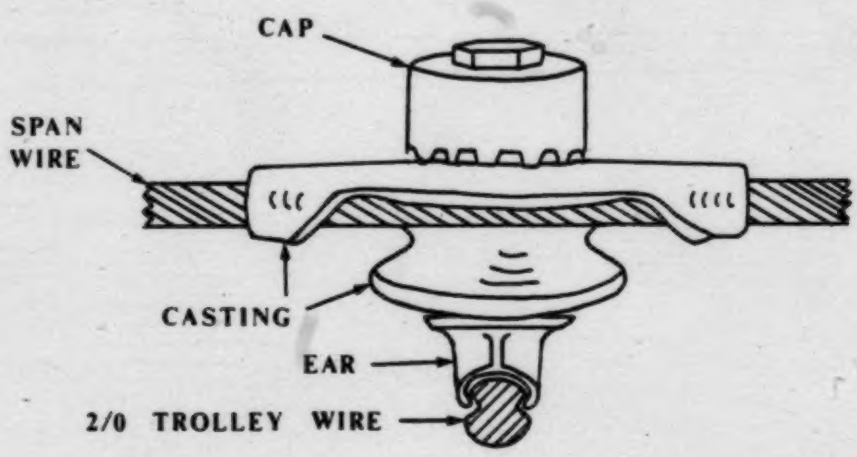


FIGURE 23. 1908 STYLE OF HANGER, EAR AND WIRE

Overhead construction on curves caused a problem. The problem was how to get the trolley wire to follow a smooth curve. A special span-wire arrangement was installed. Four poles were placed so that when span wires were strung between each one, a square was formed over the area of the curve. Varying lengths of span wire were attached to these border span wires. The shorter span wires were connected to special hangers called "curve hangers". Curve hangers were similar in appearance to straight hangers except that curve hangers had one or two large eye lugs (depending upon whether there was one or two tracks in the curve) that were designed to allow span wires to be attached to them. (Ohio Brass Company Catalog No. 23, 1940, p. 109) The curve hangers were attached to the trolley wire by plain ears. When the installation was complete, the trolley wire would conform to the shape of the curve because of varying lengths of span wire attached to the curve hangers. As an added precaution against electrical problems, the span wires attached to the curve hangers were insulated from the border span wires on the poles by means of wooden strain insulators. (Doane & Parkham, 1926, § 18 p. 19) A wooden strain insulator consisted of a short length of linseed oil impregnated hickory dowel with galvanized malleable iron castings swaged onto each end. The castings had eye lugs or clevis arrangements that allowed span wires to be fastened to them. Wooden strain insulators were designed to withstand tensile strains of at least 7,000 pounds (3 175 kg). (Westinghouse Catalog of Trolley Line Materials, 1932, p. 38) Figure 24 (after Doane & Parkham, 1926, § 18 p. 19) shows the plan view of a typical overhead layout for a double-track curve. The placement of the span wires and the strain insulators should be noted.

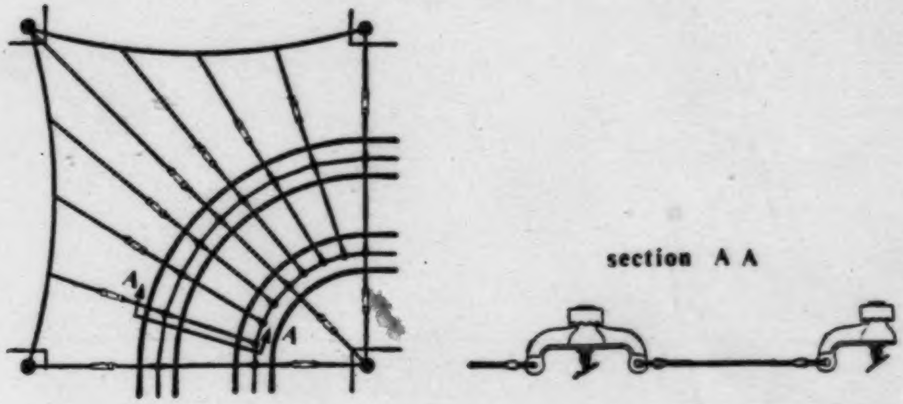


FIGURE 24. TYPICAL CURVE LAYOUT

A special item of overhead equipment was required when a switch was encountered on a street railroad track. At a switch, a streetcar had the option of proceeding straight or turning onto the diverging or converging track of the switch. In order for the trolley wheel (current collector) to remain on the wire, an overhead frog had to be installed that allowed the trolley wheel to follow one of the two possible wire paths. Overhead frogs, which were usually formed from phosphor bronze, consisted of a shallow trough called a pan that allowed three trolley wires to be connected to it by the use of special ears that fitted into hooks cast into the frog. There were also three small tapered runners in the pan that guided the trolley wheel to and from each wire. The operation of an overhead frog was simple. It was located several feet (mm) beyond the start of the switch tongues. If, for example, a streetcar began to travel onto the diverging track, the streetcar and its trolley wheel would begin to angle away from the trolley wire leading to the switch. When the trolley wheel reached the frog and the end of the wire it had been on, the twisting motion in the trolley wheel was sufficient so that it slid to the side of the pan. As the streetcar continued, the tapered runner leading to the diverging track's trolley wire would guide the trolley wheel into place on that wire. In this manner, the trolley wheel was moved from one wire to another. (Ohio Brass Catalog No. 23, 1940, pp. 120-121) Figure 25 (after Ohio Brass Catalog, p. 121) depicts the underside view of a typical overhead frog.

When two trolley wires crossed, in a three-part Y for example, another piece of overhead material was required, an overhead crossing. The operation of an overhead crossing was similar to that of an overhead frog. The overhead crossing, however, had provisions for four trolley wires and the angle of the crossing could usually be adjusted. In addition, the tapered runners were aligned so that the trolley wheel did not move to the side. It should be noted that if a streetcar travelled past a piece of overhead special work at too great a speed, the effects of inertia

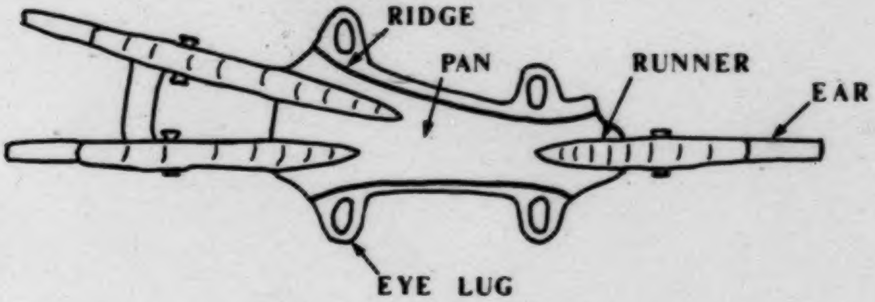


FIGURE 25. UNDERSIDE OF 15° FIXED FROG

and centrifugal force would cause the trolley wheel to dewire, cutting power to the streetcar and, possibly, causing damage either to the overhead or to the trolley pole.

It was, on occasion, necessary for two trolley wires to be spliced. It was imperative, in making that splice, that the smoothness and the electrical conductivity of the wire be maintained. To accomplish this, special phosphor bronze splicers were used to join the wires. A splicer consisted of a casting that resembled an ear. The ends of the two trolley wires were first slid into machined grooves in the splicer. The edges of the splicer were then clinched to the wires using a clinch block. This arrangement provided a strong and a smooth splice. (Ohio Brass Catalog No. 23, 1940, p. 106)

Between 1908 and the end of 1910, all of the distribution materials and construction methods heretofore described were used on the ERR. The steel centre-pole construction was primarily used on the main, heavily travelled portions of the system (Jasper Avenue for example). Wood centre-pole construction was frequently used on main streets that had not been paved, Whyte (82nd) Avenue in Strathcona for instance. Span-wire construction was generally used on curves or on streets that were too narrow for centre-pole construction. Side-bracket construction, which used the smallest number of poles, was generally installed on infrequently used lines such as turnouts or temporary track extensions. (ERR Drawings Showing Position of Poles, 1908, 1911, and Doane & Parkham, 1926, § 18 pp. 15-20)

Mechanical Production, 1911-1912

In April 1911, the ERR ordered a 500 kW synchronous motor generator from the Canadian Westinghouse Company with the intention of placing the unit in a temporary substation located near the streetcar barns on Syndicate Avenue (95th Street). (Letter from the City Secretary-Treasurer to the City Commissioners, April 6, 1911, and SRDGL, Account C20) The operation of a synchronous motor generator, while similar to the basic operation of a plain motor generator, was more complex since a synchronous motor generator was designed to regulate its output automatically without constant supervision. The commutator and the field windings of the generator were interconnected with coils located on the motor's rotor in such a way that, as the speed of the motor increased, the D.C. generated by the generator would regulate the voltage reaching the motor's rotor field windings. In normal operation, the speed of the motor generator was such that the output of the generator remained at 550 volts D.C. If, for example, the load on the generator increased so that its speed was reduced, the resulting drop in output voltage reaching the motor's rotor field windings would enable the motor to increase speed until 550 volts was produced by the generator, at which point the speed of the motor would stabilize. (A.C. Machines, Transformers, Rectifiers, 1941, pp. 65-70, and Dover, 1929, pp. 647-649) In this manner, a synchronous motor generator automatically maintained a steady D.C. output voltage. The Westinghouse unit that was purchased was well suited for economical substation work. Its 700 H.P. (522.2 kW) motor required three-phase A.C. at 2,300 volts which could be transmitted at a higher voltage to the substation resulting in minimal line loss. (Report to the City Commissioners from Power Superintendent Cunningham, November 22, 1928, p. 2, and CEAR, 1913, p. 269) The ERR constructed a small wooden frame building immediately south of Syndicate Avenue (95th Street) streetcar barns to house the synchronous motor generator. (SRDGL, Accounts C20 & C20A, 1911) Initially, three feeders originated at the substation. One travelled south along Syndicate and was connected to the trolley wire at Sutherland Street (106th Avenue). The next feeder travelled east where it connected with trolley wires at two locations, Kinnaird (82nd) Street and Agnes (79th) Street. The final feeder travelled north and then east paralleling the tracks on Kirkness (95th) Street and Alberta (118th) Avenue as far as Douglas (78th) Street. This feeder connected with the trolley wire a total of seven times. The distance between the feeder taps on this particular feeder was approximately 580 feet (176.8 m) or at every fifth support pole. (ERR Drawing Showing Feeder Lines, 1912, see Map 6 for the location of the tracks) The extensive use of feeder taps on the one feeder was intended to keep line loss to a minimum when those sections of track were in heavy use. (Dover, 1929, pp. 621-624) While the temporary substation provided some additional power to ERR tracks outside the radius of the power plant, the addition of more rolling stock coupled with the construction of new lines made the installation of more feeders and generating equipment imperative.

The perennial problems of power shortages continued to bedevil the ERR. In the 1911 Annual Report, ERR Superintendent R. Knight stated, "Spare [generating] capacity is also necessary, so that breakdowns in the generating plant will not cuase derangement of traffic and schedules such as have been experienced in the past, with their resultant financial loss to this Department" (p. 150). The late arrival of some needed A.C. equipment plus frequent failures of the gas producer plant and engine were factors in the continued power shortages experienced by the ERR. (CEAR, 1911, pp. 126-127) In addition, the old Robb steam engine connected to the 300 kW Westinghouse generator was unable to provide maximum power without overheating. On several occasions when streetcar traffic was heavy, the engine had to be shut down in order to prevent the catastrophic failure of its moving parts. When the engine was shut down, however, the power available to the ERR was reduced so that streetcar operation slowed or stopped, depending upon the output of the other generating equipment. (Edmonton Capital, November 27, 1911, p. 10) It was apparent that this arrangement could not continue.

In January 1912, the Robb engine was disconnected from the Westinghouse generator. The engine was later sold. (Edmonton Capital, January 22, 1912) The Power Plant Department decided to couple the generator (which was now considered small compared to the capacity of the synchronous motor generator) to an A.C. motor, thus producing a motor generator. (CEAR, 1912, p. 196) A 425 H.P. (317 kW) motor was ordered from the British branch of the Siemens Company of Germany. The motor did not arrive until early 1913. (CEAR, 1912, p. 196, 1913, p. 268) The ERR faced a protracted power shortage until the loss of the 300 kW generator could be compensated for in some way. In March, the ERR invited tenders for another 500 kW synchronous motor generator. (Edmonton Capital, March 16, 1912) The contract was awarded to the Canadian Westinghouse Company and when the unit arrived, it was temporarily installed in the power plant. (CEAR, 1913, p. 207) This synchronous motor generator had been purchased for a new ERR substation but the construction of the building to house this piece of equipment had not been started. By locating the unit at the power plant, the power shortage caused by the temporary loss of the 300 kW generator was alleviated.

By the end of 1912, the ERR possessed a total of 50 streetcars, both passenger and freight. (See Appendix I) The ERR had also ordered an additional 35 passenger streetcars for delivery during 1913. (Preston Car and Coach Company Contract for Streetcars, November 5, 1912) Additional generating equipment had to be obtained if the ERR was going to be able to operate the new rolling stock. Since most of the heavy streetcar traffic was located within the radius of the power plant, the Power Plant Department decided to increase its D.C. capacity. In order to accomplish this, an order was placed for one 1,000 H.P. (746 kW) Belliss and Morcom triple expansion steam engine. (PDAR, 1927) This engine was to be connected to a 750 kW, 575 volt D.C. Siemens generator that was also ordered at the same time. (CEAR, 1912, p. 196) The engine and the generator were both manufactured in England. English products were purchased because the trade tariffs of the time meant that British goods could be imported at a lesser cost than American goods. In addition, the two major North American manufacturers of heavy D.C. generating equipment, General Electric and Westinghouse, had raised their prices so that they could not compete with British made equipment. (Report to the City Commissioners from Power Superintendent Cunningham, February 7, 1928)

Power Distribution, 1911-1912

The power shortages experienced by the ERR had been thought to be the result of insufficient generating capacity. By the end of 1910, however, the Superintendent of the ERR, C. V. Biswanger, believed that the power shortages were partially caused by excessive loss in the rails. (CEAR, 1910, p. 111) It should be remembered that initial track construction did not include the use of rail bonds (bonds between rail sections at the joints). Biswanger felt that if the ERR was to overcome its power supply problems, an attempt should be made to make the distribution system more efficient. It was recommended, therefore, that all rail joints be bonded and that a negative feeder be installed. (CEAR, pp. 111-112) The installation of rail bonds in completed track did take place but at a slow rate. (CEAR, 1912, p. 207) The type of rail bond used consisted of a 10 inch (254 mm) length of heavy braided copper wire which had a large lug crimped to each end of the wire. The bond was welded to the outer side (the side where no wheel flanges would pass) of each rail head. The bond was placed so that there was considerable slack in the copper wire. This slack allowed for the expansion and contraction of the joint. (ERR Drawing of Proposed Track Construction, Type No. 1, December 1912) Plate 10 (Provincial Archives of Alberta) shows several rail bonds in place on the grand union under construction at 109th Street and Jasper Avenue. Although the photograph was taken during 1913, it illustrates the type of rail bond that was widely used on the ERR. Throughout 1912, all new track construction incorporated rail and cross bonds. (CEAR, 1912, p. 207, and Glenbow Archives Photograph NC-6-64604)

In addition to improvements to track bonding, the ERR endeavoured to improve the condition of the overhead trolley wire. The system of wire suspension that was used by the ERR (described in a previous section) held the trolley wire rigidly to the span wires. As the seasons changed and the ambient temperature fluctuated, the trolley wire attempted to expand and contract. Since the suspension did not allow for much movement, it was not uncommon for the trolley wire to stretch or to sag, causing the streetcars' trolley wheels to dewire frequently. (Doane & Parkham, 1926, § 18 pp. 20-21) In order to minimize the effects of temperature on the trolley wire, frequent maintenance of the suspension had to take place. To facilitate maintenance, a device was needed that enabled line crews to work on affected areas of the overhead, while at the same time allowing streetcars to pass.

In January 1910, ERR Superintendent Taylor received approval from the City Commissioners to purchase a horse-drawn tower wagon. (Letter to ERR Superintendent Taylor from the City Commissioners, January 3, 1910) The tower wagon, which was manufactured in Canada by the Ottawa Car Company under license from the Trenton (New Jersey) Wagon Company, consisted of a four-wheeled, two-horse wagon on which was mounted a telescoping wooden tower. The wagon could travel on the streets without the use of streetcar tracks. The tower, which could be raised and lowered by a steel cable winch mechanism, had a revolving platform on the top that was moved by a crank operated by the person standing on the platform. (Letter to the City Commissioners from ERR Superintendent Taylor, January 3, 1910, and Electric Service Supplies Co., Catalog 4, 1911, p. 544) According to Taylor, the main advantage of such a wagon was, "the man on the tower can set his waggon clear of the track, turning the platform in and out from his work every time a car [streetcar] passed". (Letter to the City Commissioners, January

3, 1910) Plate 13 (Provincial Archives of Alberta) shows the tower wagon in use sometime during 1912. Dewirements continued to be a prevalent problem in spite of increased maintenance of the overhead. In one unfortunate instance in December 1911, a streetcar's trolley wheel dewired at night while the streetcar was on the turning loop adjacent to the Swift packing plant (see Map 6 for location). Another streetcar, which had been a short distance behind, failed to see the darkened streetcar because there were no street lights at that location. The second streetcar rammed the first, injuring one of the passengers in the darkened streetcar. The result of the accident was a law suit against the City by the passenger. In an attempt to prevent a repetition of that sort of accident, the City Commissioners ordered that all streetcars were to carry a lighted kerosene lantern with a red glass on the outside of each end. (Edmonton Journal, December 29, 1911, p. 1) It was thought that the red light would be seen if the streetcar was plunged into darkness for any reason. The lanterns were purchased from a local supplier early in 1912. (SRDGL, Account T13, March 12, 1912)

Plans for extensive track extensions had been approved by the City Council during 1912. The ERR, not wishing to experience a continuation of the power distribution problems of the past, submitted complete details of the approved extensions as well as details about the present operation to a board of engineers in Montreal. (CEAR, 1912, p. 207) The ERR management hoped that the board of engineers could devise a suitable and efficient power distribution system for the ERR. (CEAR, p. 207)

Mechanical Generation, 1913-1926

The generating equipment that had been ordered by the Power House Department in 1912 arrived in early 1913 and was placed in operation.

Plate 13. (Provincial Archives of Alberta) Tower Wagon, 1910

Plate 15. (Provincial Archives of Alberta) Line Car L-1, 1913

The Westinghouse 300 kW generator was once again made operable with the installation of the 425 H.P. (317 kW) Siemens motor. The new 750 kW Siemens generator was also placed in operation. (CEAR, 1913, p. 268) That unit was driven by a Belliss and Morcom triple expansion steam engine. This particular type of engine consisted of three vertical cylinders, each of progressively larger size. The operation of the engine was similar to the operation of a compound engine except that the steam passed through an additional cylinder before being recycled. (PDAR, 1927) Plate 14 (Glenbow Archives) shows the Siemens generator and the Belliss and Morcom triple expansion steam engine in operation at some time during 1913. The man standing on the steam engine provides an idea of the size of the equipment. Directly behind the Siemens generator can be seen the Crocker-Wheeler generators.

In May 1913, the City Commissioners decided that all street railway power generating equipment was to be operated by the Power House Department. The two synchronous motor generators purchased by the ERR were transferred to the Power House Department. (CEAR, 1913, p. 269) A permanent street railway substation was being constructed immediately south of the ERR's new Cromdale streetcar barns (see Map 8 for location. The substation was completed in November 1913 and the 500 kW synchronous motor generator, formerly located at the power plant, was placed in operation there. In early 1914, the temporary substation on Syndicate Avenue (95th Street) was abandoned and its 500 kW synchronous motor generator was also installed in the new substation. In addition, the 250 kW Canadian General Electric motor generator purchased in 1908 was also installed in the substation. (CEAR, p. 269, and Report to the City Commissioners from Power Superintendent Cunningham, November 22, 1928) In order to power the synchronous motor generators,

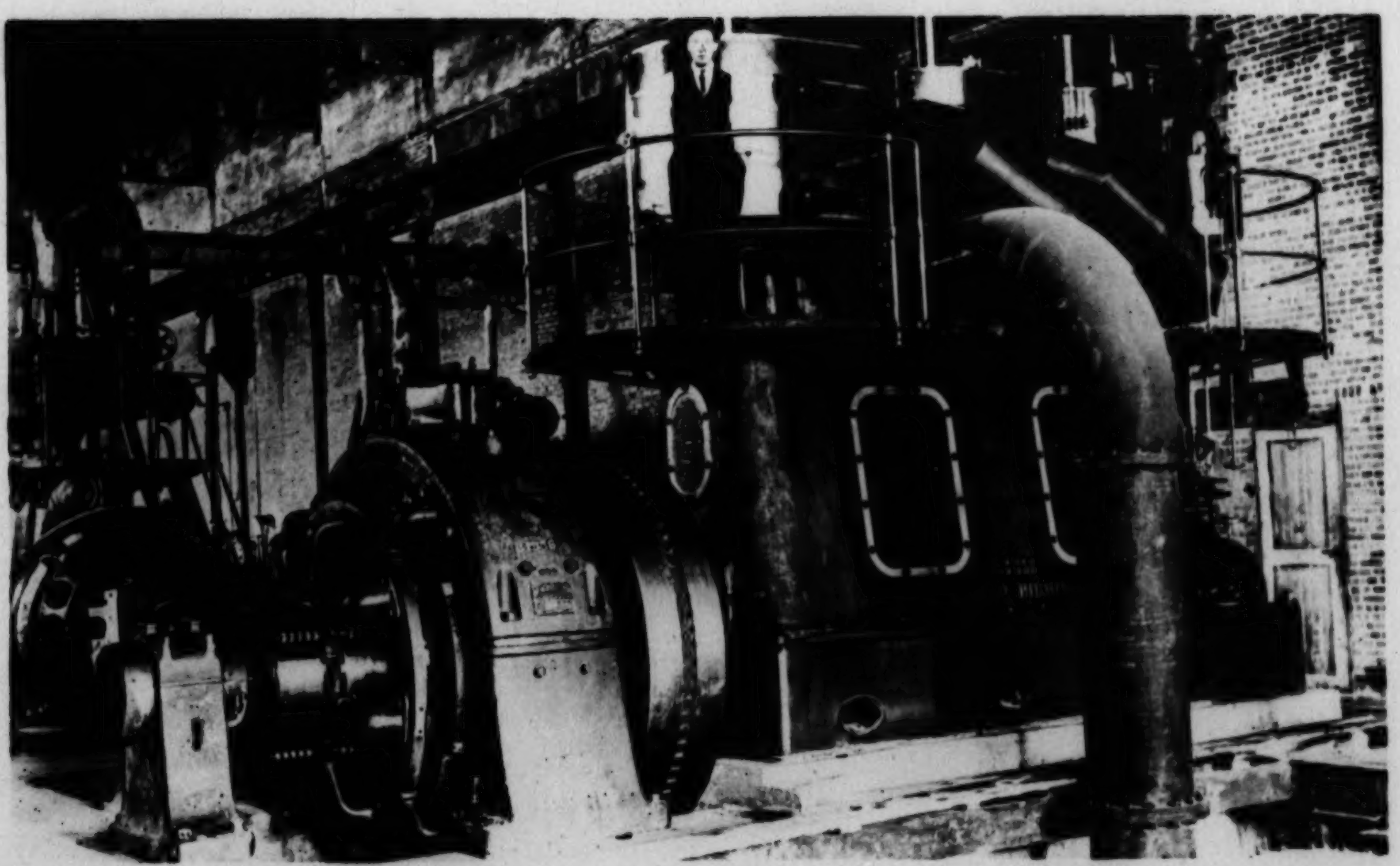


Plate 14. (Glenbow Archives) Engines and Generators at Power Plant, 1913

a high voltage A.C. line was erected between the power plant and the substation. Through the use of step-up transformers, the required 2,300 volts was transmitted to the substation at a value of 6,600 volts, which was thought to be the most economical transmission voltage (least line loss). Once at the substation, two step-down transformers provided the synchronous motor generators with 2,300 volts A.C. (CEAR, 1913, p. 269)

In 1914, the Power House Department replaced the 550 H.P. (410 kW) Robb steam engine which powered one of the Crocker-Wheeler generators with a 550 H.P. (410 kW) Belliss and Morcom steam engine. (CEAR, p. 273, and PDAR, 1927) The Robb engine was replaced because it was not compatible with the new Belliss and Morcom steam condenser. (CEAR, 1913, p. 273) At the end of 1914, based on the information cited in this chapter, the total D.C. capacity available to the ERR was 3.2 MW. This capacity was sufficient to meet the needs of the ERR until 1927 when destructive equipment failures began to diminish the total generating capacity. (PDAR, 1927, p. 7)

Power Distribution, 1913-1938

The track construction program undertaken by the ERR in 1913 more than doubled the extent of operable track. (CEAR, 1913, p. 287) As the new track was being built, a new electrical distribution system was installed. This new system, partially designed by the Montreal board of engineers, consisted of an extensive network of positive and negative feeders as well as the increased use of segmented steel poles for the three types of trolley wire suspension used in Edmonton. (CEAR, p. 288) The negative feeder system that was introduced consisted of large insulated copper cables approximately ½ inch (12.7 mm) in diameter that ran underground between the power plant or the Cromdale substation to points near special track work. At those points, the feeders entered special rectangular cast iron cabinets called "feeder pillars". The feeders entered the part of the pillar that was placed underground. The part of the pillar that was above ground contained: an ammeter that measured the amount of current entering the large feeder to the power plant from the smaller track feeders; terminal bars that enabled the track feeders to be connected to the large power plant feeder; and several switches which were used to isolate sections of track from the power plant feeder when repair crews were at work on the track. (ERR Drawing of Terminal Pillars for Negative Feeders, February 1914) Two copper earthing (grounding) plates, spaced 20 feet (6.1 m) apart, were located near each pillar and were connected by feeder cables to it. The copper earthing plates measured 3 feet (0.9 m) long by 2 feet 3 inches (0.7 m) wide and were 1/8 inch (3.8 mm) thick. The purpose of the earthing plates was to collect any current that had left the rails and was travelling through the ground. (ERR Drawing of Copper Earth Plates, February 1914) It should be noted that the negative feeder cables to the rails and to the earthing plates consisted of number 4/0 Brown and Sharpe gauge copper wire which was covered by insulation. Feeder pillars and their earthing plates were usually located near special track work because there usually was greater leakage of current to the ground at these points rather than on straight sections of track. (ERR Drawings of Negative Feeders for Special Work, 1913) In Plate 10 (Provincial Archives of Alberta) one can observe several of the insulated track feeder cables leading from the grand union. It seems that the system of negative feeder cables and feeder pillars that was used on the ERR was a system that had originated in Britain and was in common use there. (Dover, 1929, pp.

624-628) Individual feeder pillars were located at various distances from the power plant or substation. To ensure that one large feeder did not draw more current than another thereby causing electrolysis to occur, line loss calculations were made and resistors were installed on feeders that were considered to be short enough to have an effect on the current flow of other feeders leading to the power plant or substation. This action was considered to be temporary as it made the feeder system inefficient. The ERR's future plans called for the installation of voltage boosters on the long power plant and substation feeders. (ERR Plan of Negative Feeder System, December 1913) A booster was a special type of motor generator. The field windings of the generator portion were connected in series with its armature so that the output voltage of the booster would increase and decrease in proportion to increases and decreases in feeder voltage. The purpose of a booster, therefore, was to add its voltage to the feeder in order to maintain the feeder voltage at 550 volts. (Doane & Parkham, 1926, § 17 pp. 11-17) Boosters were expensive items so the City Commissioners decided to postpone the purchase of any boosters until it could be determined that they were essential. Although the negative feeder system functioned to some extent without boosters, the system did not function efficiently. This inefficiency enabled some return current to travel through the ground.

In January 1915, ERR Superintendent J. Larmonth informed the City Commissioners that electrolytic destruction of water pipes would continue to be a serious problem until the required boosters were installed. (CECR, January 5, 1915) The boosters were not purchased, however. There appears to have been two reasons for this. By the beginning of 1915, Edmonton was in the midst of a serious financial recession and the purchase of expensive and non-essential equipment was not considered to be a priority. In addition, the ridership and the traffic on the ERR fell drastically after the start of the First World War. In view of the decreased traffic, many City officials felt that the boosters were superfluous. (CECR No. 195, September 5, 1916)

The positive distribution system also underwent considerable revision during the 1913 construction. On most paved or heavily used streets the ERR and the Electric Light and Power Department installed steel poles to support the overhead wire. (CEAR, 1913, p. 288) Heavier steel poles were installed at locations where there would be greater tension on the poles. These locations included curves and special work. (ERR Drawing of Standard Wrought Iron Tubular Poles, February 1913) A new method of installing trolley wire was also adopted in 1913. Prior to this time, the wire had been strung dead along the span wires. Hangers and ears were then installed and, finally, the trolley wire was tensioned and attached to the ears (see previous section, Power Distribution, 1908-1910). In order to speed the installation of trolley wires, the ERR began to erect live trolley wires. In this method, one end of a reel of trolley wire was spliced to an existing trolley wire that was in use. The reel was mounted on a push cart in such a way that it could be unwound under tension. A line work car or a passenger streetcar with a platform on the roof would be used to propel the cart forward. As the streetcar moved forward, the trolley wire would rise and pass over the roof. When span wires were encountered, the streetcar motorman would be signalled to stop and the men on the platform would affix the trolley wire to the span wire with hangers and ears. (Doane & Parkham, 1926, § 18 p. 18) The span wire was usually insulated from the ground by the use of wooden (usually hickory) or porcelain strain insulators. It was necessary to insulate the span wires from the poles in order to prevent the line crews from becoming accidentally grounded, thus electrocuting themselves. In addition, wherever steel poles were used, span wire insulation ensured the safety of pedestrians should a hanger insulator fail and the span wire became energized. The ERR temporarily fitted passenger streetcar number 7 with a platform so that it could be used to install live trolley wire. Plate 9 (Glenbow Archives) shows passenger car number 7 in use as a line car during 1913. The reel of trolley wire and the platform on the streetcar's roof should be noted. The ERR also constructed a work car that was specifically designed for line construction. (CEAR, 1913, p. 288) Plate 15 (Provincial Archives of Alberta) shows the line car on the High Level Bridge during 1913. The location of the trolley wire wheel on the car as well as the hangers and ears on the platform should be noted. More information about the line car can be found in a subsequent chapter.

A new type of hanger was introduced in 1913. The previously used hangers consisted of a stud or bolt that was surrounded by insulating material. This assembly was held in a galvanized malleable iron casting. (See previous section, Power Distribution, 1908-1910) The new hanger that was used consisted of a small, one-piece galvanized malleable iron casting. The stud, for connecting the ear to the hanger, was implanted in insulating material that was molded directly into the casting. (Artifacts in the Author's Collection, and Canadian Ohio Brass Catalog No. 23, 1940, p. 91) The new type of hanger was smaller and was considered not to be as susceptible to insulation failure than the earlier types in use. Figure 26 (after Canadian Ohio Brass Catalog No. 23, 1940, pp. 90-91) shows the appearance of the hanger used from 1913. A new item of overhead special work was installed by the ERR during this period. The Board of Railway Commissioners (BRC), who were responsible for

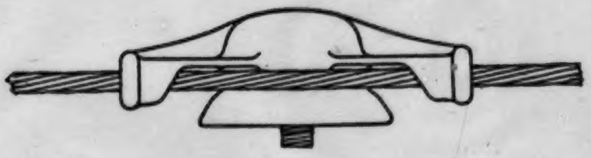


FIGURE 26. ROUND-TOP HANGER

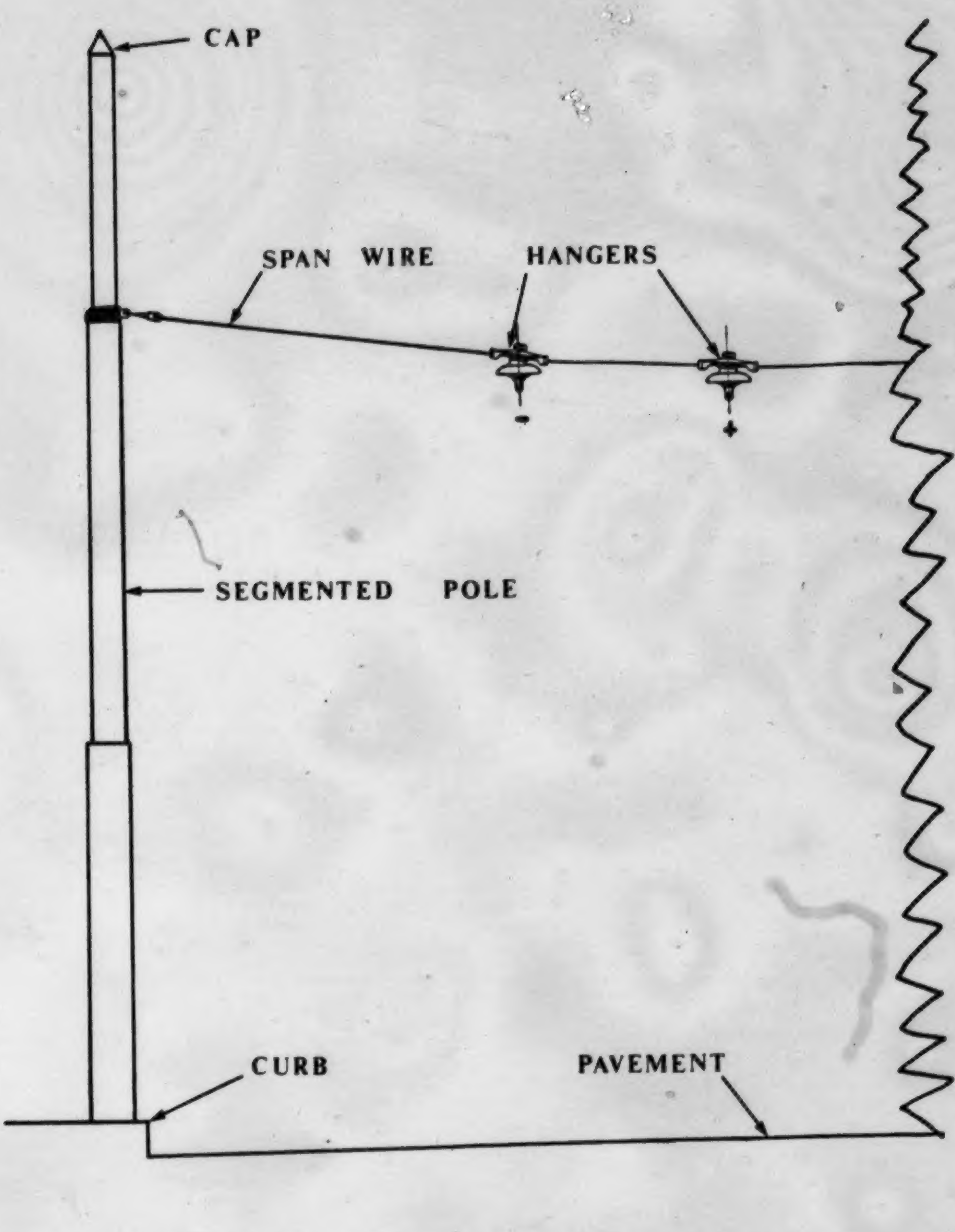

CAP
SPAN WIRE
HANGERS
-
+
SEGMENTED POLE
CURB
PAVEMENT

FIGURE 27. AN APPLICATION OF SWIVEL-TOP HANGERS

the safety of any rairoad that crossed a chartered steam railroad, ordered the ERR in 1913 to install "National trolley guard" on their lines that crossed frequently used steam railway tracks. (CECR No. 211, October 1, 1915, p. 2) National trolley guard was the patent name of a safety feature which was intended to prevent streetcars from losing electrical power as they crossed a steam railroad track. The trolley guard consisted of galvanized steel wire mesh that was fastened in a semicircular fashion around the top of the trolley wire. The wire was galvanized to prevent the formation of iron oxide (rust). Strain insulators isolated the trolley guard from the poles. The trolley guard began a few yards (metres) before a crossing, covered the entire length of the crossing, and ended several feet (metres) after the crossing. (Electric Service Supplies Co. Catalog No. 4, 1910, p. 260) The purpose of the trolley guard was to prevent a dewirement from stopping a streetcar in the vicinity of a railroad crossing. For example, if a streetcar was crossing a set of tracks and its trolley wheel left the wire, the streetcar would continue to receive power because the trolley wheel would be in contact with the galvanized mesh which was energized by the trolley wire. Once the streetcar had cleared the crossing, the motorman or conductor could stop the streetcar and could replace the trolley wheel on the wire. (Electric Service Supplies Co. Catalog No. 4, 1910, p. 258)

The positive feeder system was also upgraded beginning in 1913. In previous years, the ERR had used very few feeders. The lines that were served by feeders rarely had more than three widely-spaced feeder taps. (ERR Drawing Showing Feeder Lines, 1912) The new feeder system called for positive feeders to parallel each line, and for feeder taps to be placed either at every third pole on heavily-used lines such as Jasper Avenue, or at every fifth pole on other lines. The feeder cables were to be Brown and Sharpe number 4/0 gauge insulated copper. Besides an increase in the number of feeders and feeder tapes, the trolley wire was to be divided into electrically separable sections ranging in length from 1 to 3 miles (1.6 to 4.8 km). (Drawing of Proposed Scheme of Positive and Negative Feeders, 1913) The purpose of dividing the wire into sections was to enable the rest of the system to function if one section should develop a short circuit or a particular section required extensive repairs. By means of switches and section insulators, the affected section of trolley wire and its feeders could be isolated from the remainder of the system. In normal operation, however, all sections were connected so that a short circuit could (depending upon the number of streetcars in service at that time) either cause the circuit breaker to open or allow the area of the short circuit to heat and possibly melt the trolley wire. (Doane & Parkham, 1926, § 18 pp. 7-10) A section insulator consisted of a length, usually about 10 inches (254 mm), of 4 inch (107 mm) high, treated hickory with clamps on each end to hold trolley wire. The hickory beam was shaped so that it matched the width of the trolley wire. (Canadian Ohio Brass Catalog No. 23, 1940, p. 114) To install a section insulator in existing wire, a small piece of the wire was cut out of the existing overhead. The ends of the wires were then secured to the section insulator clamps. In new construction, the section insulators were installed as the trolley wire was being strung. The fittings on the section insulators allowed jumper cables or switch cables to be attached so that individual sections of the trolley wire could be connected together. (Canadian Ohio Brass Catalog No. 23, 1940, pp. 114-116) Later versions of the section insulators for this period had renewable reinforced rubber runners that were replaced as they wore out. Renewable runners tended to prolong the life of the wooden section insulators. (Canadian Ohio Brass Catalog

No. 23, 1940, p. 116)

By 1917, much of the original hard-drawn copper trolley wire had worn to such an extent that it required immediate replacement. (CECR No. 120, June 19, 1917) The ERR replaced several miles (km) of trolley wire during 1917 and 1918 with new hard-drawn copper wire of the same size. (CECR No. 71, May 28, 1917) The ERR was beginning to realize that hard-drawn copper trolley wire, while possessing good conductivity, did not have substantial wear resistance so the life of hard-drawn copper trolley wire on the ERR was approximately 10 years.

By 1925, the ERR was replacing worn trolley wire with a copper and cadmium alloy wire, sometimes referred to as "bronze trolley wire". (SRDAR, 1925, p. 6, and Letter to the City Commissioners from ERR Superintendent T. Ferrier, December 23, 1938) Cadmium was added to the copper in order to increase the wear resistance of the wire. (Doane & Parkham, 1926, § 18 pp. 13-14) Although the percentage of cadmium to copper was not specified in the 1925 Annual Report, it seems likely that the wire was composed of 65% copper and 35% cadmium since subsequent orders specified this type of standard alloy trolley wire. (Letter to the City Commissioners from ERR Superintendent T. Ferrier, December 23, 1938, and Modernizing Overhead for the Trolley Coach, 1937, p. 64) The type of copper and cadmium trolley wire that was used did not conduct electricity as well as hard-drawn copper trolley wire. It was believed that the alloy trolley wire would last much longer than plain copper wire, thus reducing maintenance and replacement costs. (Canadian Ohio Brass Catalog No. 23, 1940, p. 203)

The tower wagon that had been purchased in 1910 was considered obsolete by 1923. In order to use the wagon, the ERR had to ensure that two horses were kept available. Horses, unlike machines, required both constant feeding and heated shelter in winter weather. The upkeep of horses was costly to the ERR. In most instances, the line car could be used to undertake the necessary maintenance work on the overhead. The tower wagon, therefore, was rarely used. In April 1923, the ERR sold the tower wagon. The tower assembly was retained, however, and was later fitted onto a motor truck. (SRDGL, Account C11, April 1923)

Mechanical Generation, 1927-1951

By 1924, traffic had increased on the ERR so that the capacity of the D.C. generating equipment was being exceeded by 25%. (PDAR, 1924, p. 3) The Superintendent of the Power House, W. J. Cunningham, warned that this situation could not be continued in the future, "while these machines have by careful operation and maintenance successfully carried overloads for long periods, a break down of any one of them would seriously curtail the Street Railway service" (PDAR, p. 3). The City Commissioners did not recommend the purchase of additional equipment so the overloading of the existing equipment continued. On February 20, 1927, the 1912 Belliss and Morcom steam engine that had been powering one of the 400 kW Crocker-Wheeler generators suffered the effects of a broken connecting rod while the engine was operating at full power. (Letter to the City Commissioners from Power Superintendent W. J. Cunningham, February 23, 1927) A connecting rod was a part that joined the piston to the crankshaft of an engine through pins. The result of the broken connecting rod was the destruction of the cylinder head of the engine. In addition, falling parts from the engine irreparably damaged the generator that was coupled to it. The cost of repairing both the engine and the generator was thought to be in excess of replacing them with new equipment. Additional generating capacity was required at once since there was no reserve capacity. Superintendent Cunningham stated that developments in power generating technology had made reciprocating engines obsolete. Cunningham recommended the purchase of a mercury arc rectifier or a large motor generator as replacement for the destroyed equipment. (Letter to the City Commissioners from Power Superintendent W. J. Cunningham, February 23, 1927)

The power shortage on the ERR became critical on February 28, 1927 when the Siemens 750 kW generator developed a short circuit in its commutator and had to be taken out of service for several days. During that time, only half the normal service could be offered by the ERR. (Report to the City Commissioners from Power Superintendent W. J. Cunningham, March 5, 1927) In order to increase the D.C. capacity immediately, Cunningham asked for permission to purchase a used 750 kW synchronous motor generator from Calgary. The unit had been in service there since 1919 and was considered to be satisfactory for service in Edmonton. (Report to the City Commissioners from Power Superintendent W. J. Cunningham) City Council gave its approval to the purchase and the unit from Calgary was in service by April 6, 1927. (PDAR, 1927, p. 7) At this point, the total generating capacity available to the ERR was 3.65 MW. (CEAR, 1928, p. 14) Additional generating capacity was essential to prevent another generator failure from curtailing service on the ERR.

In 1928, a complete study was undertaken by Power Superintendent Cunningham of the D.C. generating system for the ERR. In his report, Cunningham stated that the existing equipment was obsolete and could no longer meet the demands of the ERR. He further stated that, "a further extension of equipment had been deliberately delayed with a view to obtaining, when necessary, the most modern apparatus to meet the requirements" (Report to the City Commissioners from Power Superintendent W. J. Cunningham, November 22, 1928). Cunningham recommended the purchase of a mercury arc rectifier for the power plant. He also advised the construction of additional substations to supplement the existing substation adjacent to the Cromdale streetcar barns. (Report to the City Commissioners from Power Superintendent W. J. Cunningham, pp. 4-5) Cunningham believed that a mercury arc rectifier was superior to a motor generator because mercury arc rectifiers: did not require frequent maintenance; had greater D.C. production capacity; had fewer parts; were more efficient; and occupied less space than a motor generator of comparable capacity. (Report to the City Commissioners from Power Superintendent W. J. Cunningham, February 5, 1929) No mercury arc rectifiers were manufactured in Canada at that time so they had to be purchased abroad. The Company that had the most experience in the manufacture of mercury arc rectifiers was the Brown Boveri Company of Baden, Switzerland. In addition, Brown Boveri rectifiers had been selected by 18 other Canadian users of D.C. (Report to the City Commissioners from Power Superintendent W. J. Cunningham) Cunningham, therefore, recommended the purchase of one 1 325 kW mercury arc rectifier from the American office of the Brown Boveri Company. The City Council gave its approval to the purchase. The unit was installed at the power plant and was in operation by December 11, 1929 (PDAR, 1929, p. 8)

In subsequent years, as additional mercury arc rectifiers were purchased, many motor generators were withdrawn from service. In 1934, however, the Power Plant Department determined that the ERR lines in the northwestern area of Edmonton were suffering from low voltages at rush hours and during extremely cold weather. To alleviate this problem, the 250 kW motor generator of 1908 which had been out of service was installed at an A.C. substation located at 129th Street and 107th Avenue. The motor generator was rewired so that it would act as a voltage booster. (The operation of voltage boosters was discussed in a previous section.) Arranged as a booster, the motor generator could be operated without constant supervision. (PDAR, 1934, p. 7) The continued use of mechanical generating equipment was temporary. By 1935, a sufficient number of mercury arc rectifiers were in service so that the generators driven by steam engines were used only for peak loads and for emergencies. (Minutes of Power Department Committee Meeting, May 2, 1935, pp. 11-15) Some mechanical units were retained and used until after the Second World War when additional mercury arc rectifiers were obtained. By 1951, enough rectifiers had been placed in service so that all remaining mechanical equipment could be removed from service and disposed of. (Report to the City Commissioners from Power Superintendent W. I. McFarland, January 25, 1951) The conversion from mechanical generation to electrical rectification was complete.

Electrical Rectification, 1929-1938

In the previous section, it was stated that a 1 325 kW mercury arc rectifier was purchased from the American branch of the Swiss Brown Boveri Company. Several advantages of such a unit over motor generators were also stated. The operation of a mercury arc rectifier was radically different from the operation of a mechanical D.C. generator. Most D.C. generators were powered either by some sort of prime mover (engine) or by an A.C. motor. Mercury arc rectifiers relied upon an A.C. power supply. The power required was 13 800 volts, three-phase A.C. at a frequency of 60 Hz. (Letter to J. L. MacGuigan from ETS Superintendent

D. L. MacDonald, August 17, 1965) In order for the rectifier to convert the A.C. to D.C., two additional components were required: a three-phase to twelve-phase auto transformer with an interphase transformer; and a single-phase auxiliary transformer. (Thompson, 1940, pp. 341-342) A Brown Boveri mercury arc rectifier consisted of a large metal cylinder called an arc chamber which was surrounded by a water jacket for cooling. A pool of mercury was placed at the bottom of the cylinder which had an electrode called the cathode attached to it. Several inches (mm) above the cathode, and insulated from it, was a cover plate that contained a number of polished iron rods called anodes. There were usually 6 or 12 main and 3 auxiliary anodes. The Brown Boveri rectifiers which were purchased contained 12 main anodes. The sides of the anodes were surrounded by sheet metal shields to protect them from the destructive ultraviolet radiation present when the rectifier was in operation. The joints where the anodes met the cover plate and where the cover plate was attached to the cylinder were sealed with mercury. The air in the arc chamber was evacuated by means of a centrifugal pump since a high vacuum was required if the rectifier was to operate properly. The vacuum was maintained by the pump. (Dover, 1929, pp. 648-657) The rectifier operated on the principle that a high vacuum area containing a vaporized conductor, in this case mercury, would allow a current to flow from the anodes to the cathode in one direction only, thereby producing D.C. It was necessary to have several anodes and several phases of A.C. for the rectifier to operate efficiently since A.C. periodically dropped to zero and periodically changed polarity. It is for this reason that a three-phase to twelve-phase auto transformer was used. The A.C. entering the primary windings would be induced into four separate three-phase secondary windings that were joined at the neutral point through an interphase transformer which was intended to stop D.C. from entering the secondary windings. While the primary windings could be arranged in either the delta or the Y (sometimes called star) connections, the secondary windings used the Y connection exclusively. Each secondary winding was connected to one main anode of the rectifier. Each set of secondary windings was 180° out of phase from the other. This meant that at least two anodes at a time would have the correct polarity to pass current to the cathode. (Dover, pp. 652-655) The operation of the rectifier depended, however, upon the presence of vaporized mercury in the arc chamber. The vaporized mercury was provided by an auxiliary system. A moveable ignition anode and two fixed excitation anodes were connected to a single-phase A.C. power supply, usually a transformer. To start the rectifier, an operator energized the auxiliary power supply. An electromagnet surrounding the shaft of the ignition anode forced it into the pool of mercury (cathode). As soon as the anode touched the mercury, the electromagnet circuit was interrupted and a spring pulled the ignition anode away from the mercury pool. An arc was then created. If the polarity of the arc was correct, the mercury was vaporized. If the arc possessed reverse polarity, an electromagnetic relay in the auxiliary circuit became energized and caused the electromagnet controlling the ignition anode to push it back into the mercury, thus extinguishing the arc. This process was repeated by the rectifier until an arc of the proper polarity was formed. Once the arc had vaporized enough mercury, the excitation anodes began to function and the arc was sustained. At that point, the three-phase to twelve-phase transformer was energized. Current could then flow from the main anodes to the cathode. The auxiliary system was left on in order to maintain an arc when there was little or no load on the main anodes. The D.C., at 575 volts, was collected from the cathode, which was positive, and from the interphase transformer connected to the secondary windings, which was negative. The successful operation of the rectifier depended upon the repeated vaporization and condensing of the mercury. Since the rectification process also produced heat, the water jacket surrounding the arc chamber served not only to cool the rectifier but also served to condense the vaporized mercury. In addition, the anodes required some cooling. Metal cooling fins attached to the anodes and exposed to the surrounding air were considered sufficient for the anodes of Brown Boveri rectifiers. (Dover, pp. 649-659) Plate 16 (Edmonton Power Photograph) shows the original Brown Boveri rectifier as it appeared in 1981. The indicated parts of the unit should be noted.

In 1930, an additional Brown Boveri 1 325 kW rectifier and transformer was purchased and was installed at the substation south of the Cromdale street barns. (CECR No. 12, March 10, 1930)

Electrical Rectification, 1939

As early as November 1928, the Superintendent of the Power Department, W. J. Cunningham, called for the construction of additional D.C. substations for the ERR. Cunningham stated that additional substations had not been constructed in the past because they needed to be supervised by operators at all times and this was costly. It was also stated that substations equipped with mercury arc rectifiers did not need operators. (Report to the City Commissioners from Power Superintendent W. J. Cunningham, November 22, 1928) The economic depression of the 1930's stopped any plans for the construction of substations. Several outlying sections of the ERR suffered from extremely low voltages. The most notable area was the track to Calder north of 118th Avenue. That section was beyond the effective range of feeders from the power plant and

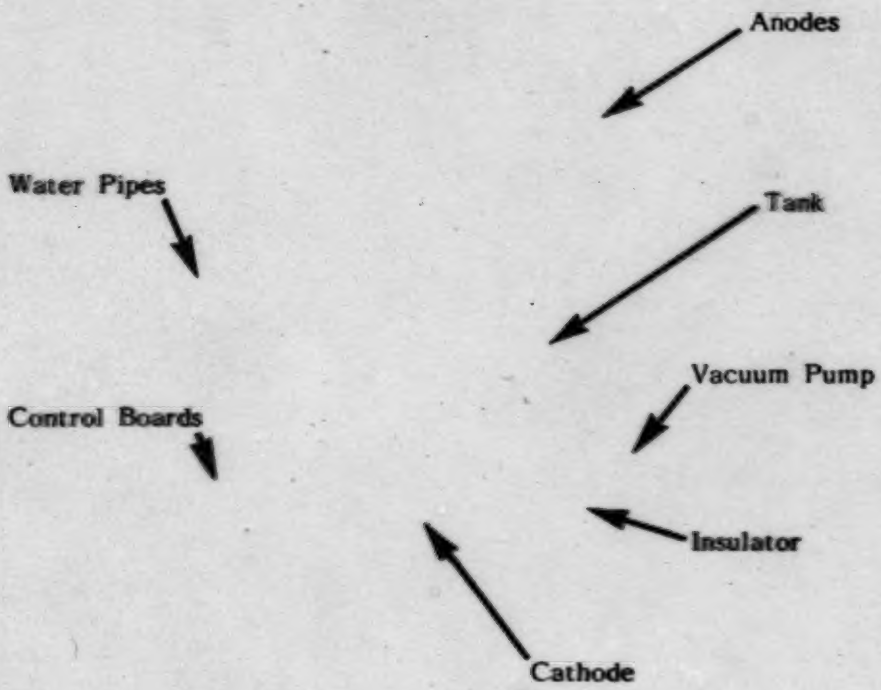

Anodes
Water Pipes
Tank
Vacuum Pump
Control Boards
Insulator
Cathode

Plate 16. (Edmonton Power) 1929 Brown Boveri Mercury Arc Rectifier in 1981

Plate 17. (City of Edmonton Archives) 1946 International Truck with Wooden Tower during late 1940's

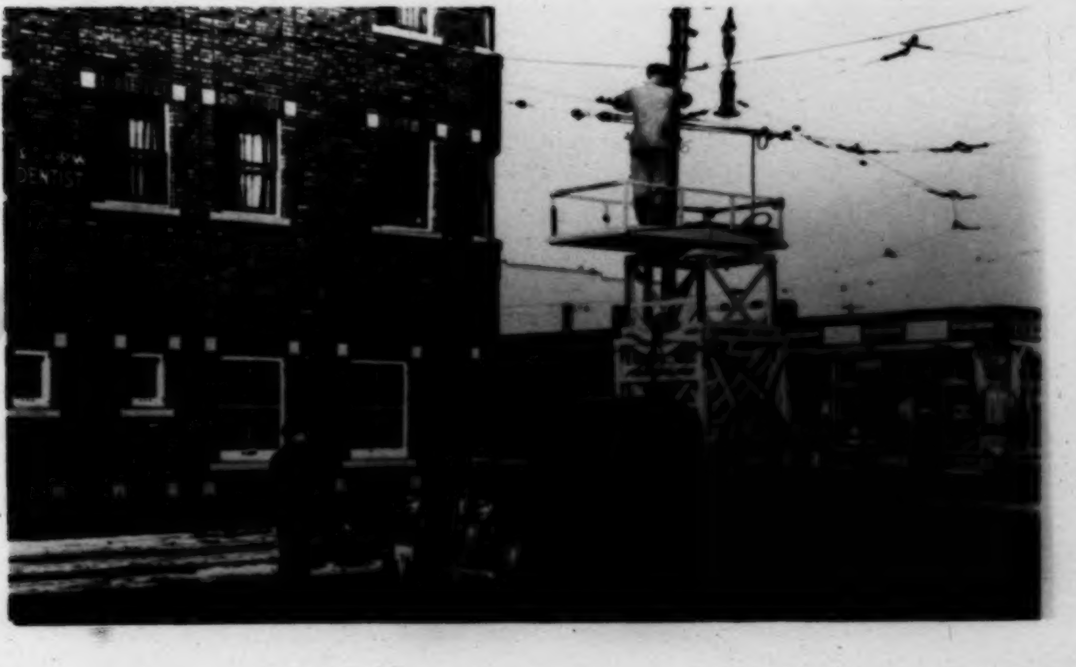


Plate 16. (Edmonton Po
Mercury Arc

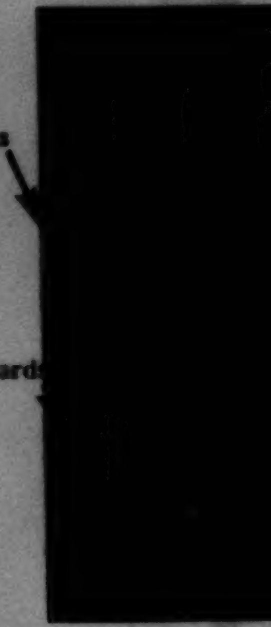
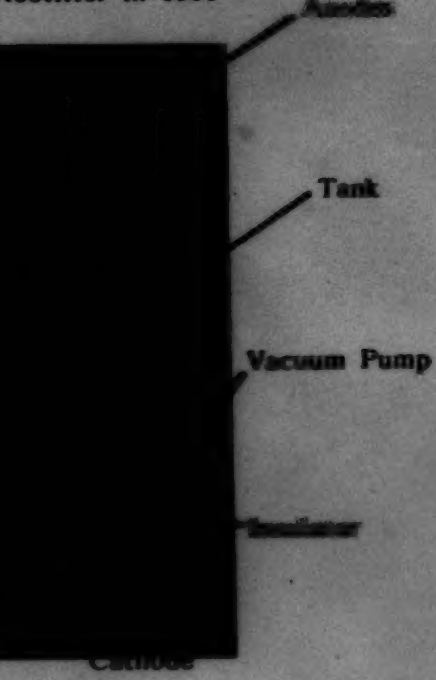

Water Pipes
Control Board

Plate 17. (City of Edmonto
Truck with Woode

er) 1929 Brown Boveri
Rectifier in 1981


Anodes
Tank
Vacuum Pump
Insulator
Cathode

Archives) 1946 International
Tower during late 1940's

the Cromdale substation. It was mentioned in a previous section (Mechanical Generation, 1927-1951) that a motor generator had been installed as a voltage booster for that line in 1934. By 1937, however, the lack of a suitable feeder system on that line was causing serious problems with water pipes in the area. The Superintendent of the Electric Light and Power Department (EL&PD), W. Barnhouse, noted that many water pipes in the Calder area had been severely damaged by electrolysis. (Letter to ERR Superintendent T. Ferrier, November 27, 1937) The ERR was also contemplating the use of trolley buses so it appeared that additional D.C. capacity was required. (SRDAR, 1938) Based upon W. J. Cunningham's recommendations of 1928, a new D.C. substation was constructed on the southeast corner of 124th Street and 107th Avenue during 1938. The fully automatic substation was to contain a mercury arc rectifier. (CECR, January 11, 1939) Several improvements had been made to the design of mercury arc rectifiers since 1930. One serious disadvantage of the Brown Boveri rectifiers was that if a problem developed with an anode or with the vacuum pump, the entire unit had to be shut down until the necessary repairs had been made. In addition, Brown Boveri rectifiers required a water supply for the arc chamber water jacket. By 1938, the Hewittic Company, a British concern, had developed an air cooled rectifier that used several glass bulb assemblies instead of a single arc chamber.

The operation of a Hewittic rectifier was similar to that of the Brown Boveri rectifiers. In the Hewittic system, instead of one large arc chamber, several smaller glass bulbs were used. Each bulb consisted of a central portion that contained the mercury pool, the cathode and the auxiliary anodes. Radiating from the central portion were six tubular glass "arms", each with a main anode attached to the end. Each bulb was a fully contained unit, and was sealed at the factory. No vacuum pump or mercury seals were required, therefore. (Hewittic Company Specifications, 1938) The entire rectifier unit consisted of several bulbs connected in parallel, the usual number was four, which gave the rectifier a 1000 kW capacity. Additional bulbs could be added to increase the unit's capacity. The advantage of the Hewittic system was that the rectifier could continue to function should one of the bulbs fail. Through a system of isolating links and switches, the affected bulb could be removed without shutting down the entire unit. The capacity of the rectifier would, however, be diminished. (Hewittic Company Specifications, 1938) The rectifier bulbs were enclosed in sheet steel cabinets. Each cabinet was connected to a ventilating fan which forced cool air over the bulbs, thus cooling them. The initial Hewittic rectifier installed at the new substation contained three bulbs and had a capacity of 700 kW. The main transformer was designed, however, to enable the unit's capacity to be increased to 1 000 kW with the addition of another bulb. (Hewittic Company Specification and Tender, 1938) The new substation was placed in operation in January 1939. (CECR, January 11, 1939) The problem of electrolysis and loss of power in the Calder area appeared to be eliminated by the new substation.

In a report to the City Commissioners, Power Plant Superintendent R. G. Watson stated,

> The operation of the rectifier has made it much easier for the cars to maintain schedules in the west end, as they have been able to accelerate faster. . . . The faster acceleration lightens the duty on the car motors and will, no doubt, show a lessening in maintenance of the motors. (February 6, 1939, p. 2)

The arrival of the Second World War was to put a stop to further installations of rectifiers until they could again be easily obtained from Britain.

Power Distribution, 1939-1946

In 1938, the ERR and the City Council decided to follow some of the recommendations of the Wilson and Bunnell Report (1938). This report called for the replacement of streetcars with trolley buses on certain routes of the system. (Wilson & Bunnell, 1938, pp. 1-2) Planning for the new trolley bus system had begun by October 1938. (SRDAR, 1938)

Electric trolley buses could not use a straight ground return system as the streetcars did. Trolley buses travelled on rubber tires and did not require any form of fixed roadbed. In order for a trolley bus motor to be connected to a D.C. circuit, therefore, the return portion of the circuit (the negative) was usually in the form of a second trolley wire suspended next to the positive wire. The negative wire was usually placed closest to the curb. To prevent the possibility of the two wires touching, they were placed a standard distance apart, 24 inches (610 mm). (Modernizing Overhead Construction for the Trolley Coach, 1937, pp. 1-26) Initial construction in Edmonton used 2/0 grooved alloy wire that consisted of 65% copper and 35% cadmium. (Letter to the City Commissioners from ERR Superintendent T. Ferrier, December 28, 1938) Although trolley bus wires were suspended in a similar fashion to streetcar wires, there were certain problems with trolley bus wires that required consideration. Fixed overhead frogs could not be used by trolley buses since they did not travel along a fixed roadbed. A system of moveable overhead switch points was, therefore, required. Whenever two sets of trolley wires crossed or converged, crossing positive and negative wires had to be insulated from one another to prevent short circuits. New types of steel and bakelite insulators replaced the previously used hickory section insulators.

In addition, most trolley buses did not use wheel current collectors but used current collectors made of steel or pressed carbon called "shoes". (Modernizing Overhead Construction for the Trolley Coach, 1937, pp. 5-7) The steel or carbon shoe was formed with a groove and like a trolley wheel ran on the underside of the wire. The groove enabled the shoe to remain in place on the wire. The shoe was held in a device called a "harp" which was connected to the trolley pole and which allowed the shoe to swivel so that the trolley bus could move laterally across the road without causing the current collectors to dewire. (Ohio Brass Publication K-336-R, pp. 1-6) The most common forms of trolley bus line suspension were the span-wire and the side-bracket varieties. Centre-pole construction was considered obsolete because the poles usually interfered with the safe operation of motor vehicles as well as trolley buses. In addition, the placement of the poles in the middle of the road usually did not allow trolley buses to reach the curbs of the road. The initial trolley bus route in Edmonton, however, did share the streetcar centre-poles along Jasper Avenue for ½ mile (0.8 km). (Ferrier, 1946, p. 18) Different types of hangers and ears were required for trolley bus lines since any deviation in the thickness or the alignment of the wires could cause the shoes to dewire. Swivel-top hangers were used because they could compensate for the sag in span wires, thus keeping the trolley wires on a vertical plane. Figure 27 (after Canadian Ohio Brass Catalog No. 23, 1940, p. 15) shows the application of the swivel-top hangers in span-wire construction. Clinch ears could no longer be used since the pounding required to clinch them to the wires could frequently kink the wires causing the shoes to leave the wires at those points. Clamp ears were used instead. They were galvanized malleable iron castings that were made in three pieces. Two smaller clamp pieces were connected to a larger body piece with brass or bronze screws. The body and the clamp pieces gripped the trolley wire tightly without bending it. (Canadian Ohio Brass Catalog No. 23, 1940, pp. 16-17)

New methods of curve construction had been developed for trolley bus lines. For gradual curves, the traditional arrangement of curve hangers was used. For tight curves, such as 90° bends, several pre-formed galvanized steel curve segments were used. These segments, which were manufactured in several degrees of curvature, were designed to be inserted into the wires. With most previously used special work, the trolley wires had to be cut in order to install these items, such as crossovers. The segmented curves, however, had special approach/anchor tips which guided the trolley wires above the curve segment. The trolley wires then passed around curved strain plates that supported the wires in place. The shoes, however, would travel along a steel runner that was parabolically shaped to the correct degree of curvature. The space between the runners and the strain plates usually contained some sort of anti-trapping casting which was intended to prevent a dewired pole from becoming wedged in the curve segment. After passing along the runner, the shoes came into contact with the trolley wires again, which had passed through another set of approach/anchor tips. Several segments were required for most curves. A 90° curve, for example, could be fabricated with two 45° segments. Three 30° segments could also be used. It should be noted that the wires between the curve segments travelled in a straight line. The transition from straight to curve tended to reduce the allowable speed of trolley buses through the curves. This was necessary to avoid dewiring the shoes. The use of special work that did not require the trolley wire to be cut was an improvement that facilitated the construction of overhead lines. Besides ease of construction, segmented curves required fewer support wires than an assembly of curve hangers, so curve segments were esthetically more pleasant. Figure 28 (after Canadian Ohio Brass Company Catalog No. 23, 1940, p. 26) shows a plan view of a typical segmented curve with the components labelled.

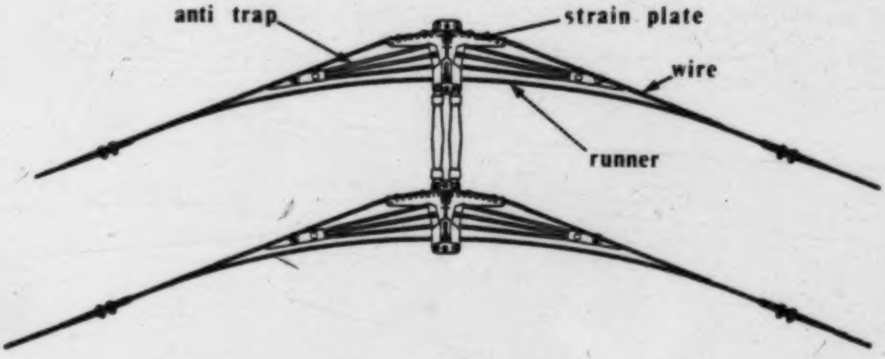


FIGURE 28. OHIO BRASS 45° CURVE SEGMENT

Edmonton's initial trolley bus lines were designed by engineers of the Canadian Ohio Brass Company, the Canadian office of an American concern, that manufactured overhead hardware. (Ferrier, 1946, p. 20) The actual installation of the overhead was done by a local contractor under the supervision of the Canadian Ohio Brass personnel. (CECR No. 15, April 24, 1939) Although there were European manufacturers who produced overhead hardware that provided vertical flexibility to trolley bus wires, the prevalent political climate in Europe at that time, 1938-1939, precluded the consideration of such overhead systems for use on the ERR.

Both positive and negative feeders were required for trolley bus lines. Initially, positive feeder taps were located at ½ mile intervals, approximately every seventh or eighth pole. Negative feeder taps were usually located at the next pole along from a positive feeder tap. While positive feeders were usually aerially suspended cables, the initial negative feeders were either old streetcar tracks or the buried negative feeder cables. Negative feeder taps, therefore, travelled from the negative trolley wire down to the rails or buried cables. (Power Plant Department Drawing of Trolley Bus Poles and Feeders, October 1938)

Electrical Rectification, 1945-1981

The need for more D.C. capacity became apparent in 1942 when the ERR received three more British trolley buses and ordered three more from the United States (see Appendix I). A new substation at 105th Avenue and 103rd Street was proposed but was not built. (CECR, January 22, 1943) Wartime conditions did not allow most street railways to purchase additional mercury arc rectifiers so the new substation had to be postponed until the end of the War. The new substation was built during 1945 and was equipped with one 1 000 kW Hewittic rectifier. (EL&PDAR, 1945, p. 2) During 1949, the original Hewittic rectifier at the substation at 107th Avenue and 124th Street was upgraded to 1 000 kW. (Wilson, 1949, p. 36)

Other brands of rectifiers were being manufactured by this time but the ETS had been satisfied with the Hewittic type. In 1949, a firm representing the English General Electric Company (GEC) submitted a low bid for a new rectifier. The GEC rectifier operated in the same manner as the Hewittic rectifiers except the GEC unit used steel tubes rather than glass bulbs. The GEC rectifier was purchased despite initial apprehension about the steel tubes. (Letter to the City Commissioners from Power Superintendent W. I. McFarland, May 12, 1949, p. 2) The rated capacity of the GEC unit was 1 275 kW. The new unit was placed in the substation at 107th Avenue and 124th Street. The original Hewittic rectifier was moved to the substation at 105th Avenue and 103rd Street to supplement the existing 1 000 kW Hewittic unit already there. (Letter to J. L. McGuigan from ETS Superintendent D. L. MacDonald, August 17, 1965)

In 1950, the Power Department decided to eliminate all operators from D.C. substations as a cost-saving measure. To facilitate this, an additional rectifier was purchased so that the water cooled Brown Boveri rectifier at the Cromdale substation could be removed to the power plant. The Brown Boveri rectifier required occasional operator supervision. (Report on Substations by Power Superintendent W. I. McFarland, January 25, 1951) The replacement rectifier was a 1 700 kW Hewittic unit. (Letter to J. L. McGuigan from ETS Superintendent D. L. MacDonald, August 17, 1965) The aggregate capacity of the power supply serving the ETS by the end of 1950 was 7.6 MW. This capacity was far in excess of the system's requirements so the original Hewittic rectifier, which had been producing some unwanted interference with the telephone system, was shut down. (Letter to C. B. Diplock from Commissioner R. J. Gibb, January 19, 1944, and EPAR, 1967, pp. 4-5)

No further changes to the rectification system came until 1967 when the original Hewittic rectifier was moved back to its initial location at the substation at 107th Avenue and 124th Street and reactivated. This was done in order to improve the power supply for trolley buses operating on new lines in the western end of the City. (EPAR, 1967, pp. 4-5) In 1976, the trolley bus system was extended in southern Edmonton. An additional substation in the vicinity was required. A small building was erected at the southwest corner of 109th Street and 61st Avenue. (Personal Observation by Author) The remaining 1 000 kW Hewittic rectifier at the 105th Avenue and 103rd Street substation was moved to the new substation. (Information from Edmonton Power)

By 1976, construction of the new Light Rail Transit (LRT) system was well underway. The power supply chosen for the new system consisted of solid state rectifiers. Mercury arc rectifiers were considered obsolete, not as efficient as solid state units and hazardous. (Information from Edmonton Power) It should be remembered that mercury arc rectifiers produce heat in operation, which means that some portion of the supply voltage was being dissipated as heat instead of being rectified. In addition, mercury was found to be a toxic material so a hazard existed for repair and maintenance crews.

The rectifiers serving the trolley bus system began to show signs of wear by 1980. By 1981, Edmonton Power determined that the cost of overhauling the original (1929) 1 325 kW Brown Boveri rectifier was greater than replacing it. In 1981, after 52 years of service, the unit was replaced by a solid state rectifier. The second Brown Boveri unit (1930) was also removed from service during 1981. (EPAR, 1981, p. 21) Future plans call for the gradual replacement of all mercury arc rectifiers with solid state units. When this changeover has taken place, the transition from electrical to electronic rectification will be complete.

Power Distribution, 1947-1951

Following the end of the Second World War, the ETS began to expand its trolley bus system. By 1947, many new lines had been installed. The older type of hanger was superseded by a newer design that was clamped to the span wire instead of being hooked onto it. In addition, the new hanger employed a replaceable molded rubber compound as the insulating material. The insulator was also separated from the surrounding metal shell by an air gap which provided greater protection against electrical leakage as the result of insulator failure. (Canadian Ohio Brass Catalog No. 25, 1948, p. 17) It was mentioned in the previous section on power distribution that moveable frogs or switch points were required where trolley bus lines converged or diverged. At locations where lines converged, trailing switches (sometimes called trailing frogs) were used. As the shoes approached the main set of wires, curved steel runners would be encountered that connected the branch wires to the main wires. As the shoes continued along, they would push the frogs so that they deflected and were aligned with the branch wires, thus presenting a smooth path to the main set of wires for the shoes. The switch points would be reset to their original position by the passing of a trolley bus along the main set of wires. (Canadian Ohio Brass Catalog No. 25, 1948, pp. 52-52A) Where trolley bus lines diverged, however, mechanically operated switch points were required so that the frogs could be aligned to the diverging wires before the shoes reached that point. The ETS used two types of electrically operated frogs; both types were manufactured by the Ohio Brass Company. The first type, known generally as selectric frogs, consisted of two parallel frogs that were each deflected by a solenoid arrangement located on top of the frog. The solenoids were protected by sheet metal covers. A contactor was placed on each wire at a different distance in front of each frog. This staggering of the contactors was arranged so that as a trolley bus started to turn a corner, thus diverging from the straight wires, the shoes would touch each contactor simultaneously, completing an electrical circuit through both solenoids. The switch points, having been deflected by the solenoids, on, power-off switch) did not employ staggered contactors. Insulated "power" contactors which were arranged in parallel on the wires before each switch caused the solenoids to operate. A power contactor consisted of a short runner that was insulated from the trolley wire and was connected to one of the solenoids. As a trolley bus approached the two power contactors, the operator of the bus could either keep his foot on the control pedal (power-on) or he could remove it (power-off). If the trolley bus was drawing power, an arc would occur as the insulated section of the overhead was reached. The extremely short length of the insulator enabled some power to pass from the shoe into the runner of the power contactor. This action completed a circuit with the solenoid connected to that contactor. Since the contactors were arranged in a parallel fashion, both frogs would be deflected simultaneously and the shoes would travel onto the other set of wires. After passing through the frogs, the shoes would reset the switch points by pushing levers. If a bus was to travel on the main wires, the bus operator kept his foot off the power pedal. No power would pass into the contactors, therefore. The solenoids would not be activated and the trolley bus would continue along the main wires. It should be noted that the power contactors could be located several feet (metres) in front of the switch. In such cases, the wires leading to the solenoids were supported above the trolley wires by means of phenolic insulators which were clamped to the upper portion of the trolley wires. (Canadian Ohio Brass Catalog No. 25, 1948, pp. 60-61) Small rectangular signs were usually placed near TER switches in Edmonton. The signs consisted of a white background with the word "power" printed in red letters. A red arrow, located beneath the word, indicated the alignment of the switch points if power was applied to the contactors. (Photographs and Observations by the Author) This visual would enable the shoes to travel to the wires leading around the corner. After passing through the frogs, the shoes would strike levers that would return the frogs to their original position. If a trolley bus travelled straight through the switch, the solenoids would not be activated because the poles of the trolley bus would be parallel on the wires, not staggered as in a turn. The shoes would, therefore, touch each contactor at different times so a complete circuit to the solenoids would not be formed. Figure 29 (after Canadian Ohio Brass Catalog No. 25, 1948, p. 58) shows the underside of a typical electrically operated frog which is aligned to the main wire.

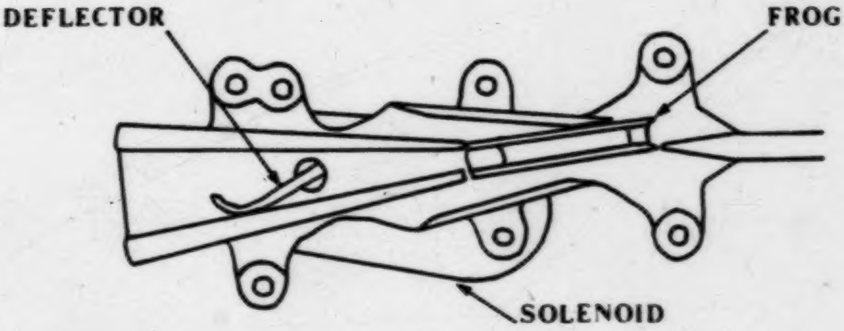


FIGURE 29. UNDERSIDE OF ELECTRIC FROG

The other type of electric frog that was used by the ETS was designated "TER". This type of switch was designed to enable a trolley bus travelling in tangent (a straight line) to be switched onto a parallel set of wires. The operation of a TER frog (often referred to as a power-aid assisted bus operators with the operation of TER switches.

A new improvement to some section insulators was introduced during this period. In the past, section insulators had consisted of some form of insulated runner which separated live sections of trolley wire. As streetcars and trolley buses passed these insulators, arcing would frequently occur between the current collectors which were on the insulated runners and the end of the trolley wire. The ultimate result of this action was the destruction of the runner. In an attempt to prolong the life of the runners, the Ohio Brass Company developed an attachment for existing section insulators which consisted of a large magnetic coil that was placed above the runner. As the current collector passed from the wire to the runner, current would flow through the coil. This action would cause a strong magnetic field to be formed around the coil. The magnetic field tended to deflect any arc up and away from the runner, thus preventing the latter's destruction. (Canadian Ohio Brass Catalog No. 25, 1948, p. 50A) The use of such magnetic coils was not widespread on the ETS, however, (Observations by the Author)

During this period, a new type of feeder tap was introduced for use in span-wire construction. In previous installations, an insulated cable would be used to connect the feeder cable to a special feeder ear on the trolley wire. The connecting cable was usually secured to the existing span wire. If there were two sets of trolley wires on the span wire, two connecting cables were strung from the feeder to the feeder ears. This arrangement was unsightly and it also added considerable weight to the span wire. The Ohio Brass Company had developed a new system that eliminated much of the hardware and connecting cable hitherto needed for feeder taps. With the new system, when the location of a feeder tap was determined, a special span wire was strung between the poles. It consisted of two lengths of regular span wire at each end of a length of insulated feeder tap cable. By means of porcelain or wood strain insulators, the middle portion of the span was secured to and insulated from the regular span wires at each end. A small length of feeder tap cable was used to connect the feeder span to the feeder cable. The feeder current reached the trolley wires through specially shaped feeder hangers. These hangers consisted of a length of hickory dowel with castings on each end. The castings were of uneven height in order to compensate for the sag of the feeder span. In this way, the bottom of the hanger assembly would lie horizontally when attached to the feeder span. Both castings were attached to the feeder span but only one of the castings was arranged so that it provided an uninsulated path between the feeder span and the clamp ear. In this fashion, power was fed into the trolley wires. Figure 30 (after Canadian Ohio Brass Catalog No. 25, 1948, p. 35) shows a typical feeder span arrangement for a double trolley bus line. The figure depicts the feeder hangers arranged for negative feeding.

Throughout this period, the use of streetcars declined in favor of trolley and motor buses. By the end of 1948, therefore, the original centre-pole construction along Jasper Avenue, which did not allow proper trolley bus operation, was replaced with span-wire construction. (Memorandum to ETS Superintendent T. Ferrier from Assistant City Engineer J. D. MacDonald, January 14, 1948) In usual practice, streetcar tracks were removed from a street immediately following the termination of streetcar service. In some cases, however, the ETS left the rails in place so that they could be used as negative feeders for the negative trolley wires until a system of aerially suspended negative feeder cables could be installed. An example of this were the tracks along 101st Street

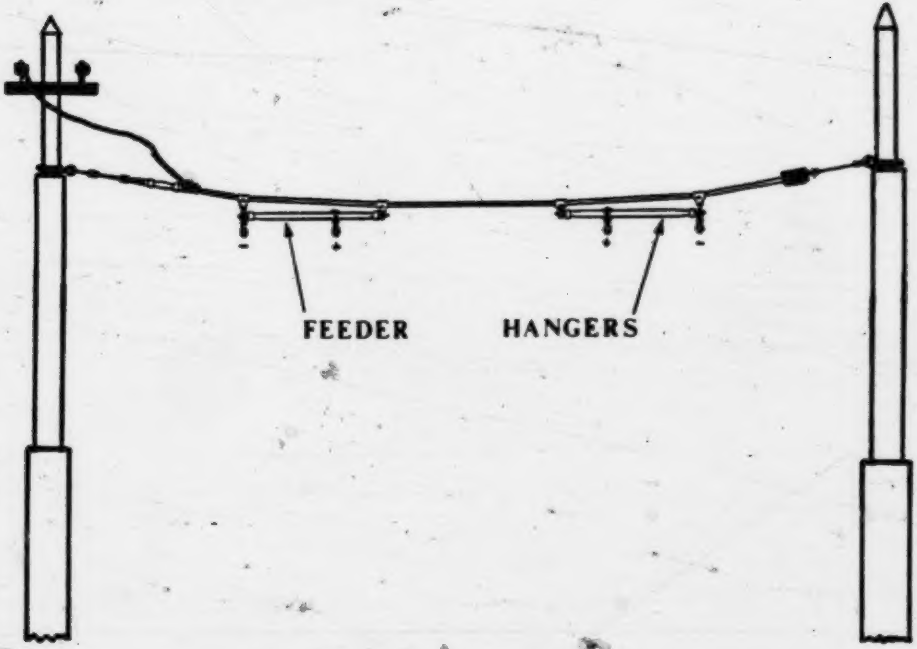

FEEDER
HANGERS

FIGURE 30. FEEDER SPAN ARRANGEMENT

between Jasper and 107th Avenues. Although streetcar service had been withdrawn from 101st Street during 1950, the rails remained in place throughout 1951 because they were being used as negative feeders for the trolley bus wires. (Letter to the City Commissioners from ETS Superintendent T. Ferrier, April 20, 1951)

With the increased use of the trolley bus, the need increased for a line maintenance vehicle that did not travel along rails. Many of the new trolley bus lines did not travel in areas where there were streetcar tracks so it was not possible for the line car to service most trolley bus lines. Although the tower wagon had been sold in 1923, the tower assembly had been retained. Two motor trucks were outfitted for line work during this period. One unit, a 1946 International pickup truck, was fitted with the old wooden tower assembly. In 1947, a larger International flatbed truck was purchased and was fitted with a wooden platform that was raised and lowered by a hydraulic cylinder system. (ETS Statement of Account 22205, January 1960, and Provincial Archives of Alberta Photograph GS 464) Plate 17 (City of Edmonton Archives) shows the 1946 International pickup truck with the wooden tower in line service during the late 1940's.

Power Distribution, 1952-1977

In a 1951 report of an evaluation of the ETS, Stevenson and Kellogg noted that maintenance of the power distribution system was somewhat inefficient because responsibility for it was divided among two departments. The EL&PD was responsible for the feeder lines between the substations and the feeder taps, while the ETS was responsible for the construction and maintenance of the trolley wire system and the feeder taps. (Stevenson & Kellogg, May 1951, p. 106) As a result of the Report's recommendations, responsibility for the construction and maintenance of the entire trolley bus power distribution system was given to the EL&PD. The ETS, however, still retained the authority to determine the placement of the wires and the type of materials to be used. (Letter to the City Commissioners from ETS Superintendent T. Ferrier, December 19, 1951)

During this period, minor improvements were made to the system. Some trolley bus lines, for example, were moved closer to the sides of the road in order to allow trolley buses to pull up to the curb for passenger loading and unloading. Trolley wheel current collectors were no longer used on the ETS following cessation of streetcar service in September 1951. The need for alloy trolley wire with a high percentage of cadmium became unnecessary because carbon shoe collectors did not abrade trolley wires as much as trolley wheels. In addition, the conductivity of trolley wire dropped in an inverse proportion with the amount of cadmium in the alloy. As early as 1948, many wire manufacturers were producing a "high conductivity" alloy trolley wire specifically suited for carbon shoe collectors. The new alloy was 80% copper and 20% cadmium. This alloy improved the conductivity of the wire without completely eliminating wear resistance. (Canadian Ohio Brass Catalog No. 25, 1948, p. 192) The new alloy wire was installed wherever new lines were constructed or when older wires were replaced. (Letter to the City Commissioners from ETS Superintendent T. Ferrier, December 19, 1951)

A significant change introduced in 1952, which helped to improve trolley bus efficiency, was the use of three 30° curve segments for 90° bends. Prior to this time, such bends had been composed of two 45° segments. ETS Superintendent T. Ferrier stated, "it is found that by using three 30° curve segments much better alignment is obtained, and in addition operating conditions are improved, resulting in less wear on equipment and longer life of the overhead" (Letter to the City Commissioners, December 19, 1951).

With the termination of streetcar service in 1951, the ground return system of distribution was abandoned in favor of a floating system. It should be remembered that trolley buses obtained their power from two trolley wires, positive and negative. Current could, therefore, travel to and from the rectifier station without passing through the ground. By not using the ground, the problem of electrolysis would be solved. In the past, some negative trolley wires had been fed by connecting them to streetcar rails or to buried feeder cables. The abandonment of the street railway enabled the rails to be removed, which forced the installation of a system of aerially suspended negative feeder cables. Improvements to the feeder system took place gradually but in new construction, the termini of many distant lines were not fitted with a sufficient number of feeder taps. (Observations by the Author) For several years during the 1960's, it appeared as if trolley bus service was going to be removed gradually. In consequence, very few improvements to the overhead took place. (ETSAR, 1966)

By the early 1970's, some portions of the existing overhead were in need of replacement. In an attempt to keep costs to a minimum, in 1971 the City purchased several miles (km) of used trolley wire and the necessary hardware from Winnipeg which had terminated its trolley bus operations. (Letter to ETS Superintendent D. L. MacDonald from Edmonton Power, March 3, 1971) The used material postponed a general replacement of Edmonton's trolley bus lines. Additional used stock was purchased from Calgary in 1975 after that City terminated its trolley bus operations. The hardware from Calgary was used to extend existing lines in Edmonton. (Edmonton Journal, August 1, 1975, p. 7, and Author's Observations) The use of these recycled materials enabled the trolley bus system to be expanded without great expense. The speed and the efficiency of the system could not be improved, however, until the hardware of the system was improved.

Electronic Rectification, 1976-1981

During 1974, the City began the construction of a Light Rail Transit (LRT) system. The electrically-powered vehicles to be used on the system were to travel along a private right of way which was located underground as well as on the surface. Consideration had to be given to the type of electrical power to be used and how it was to be produced. The type of vehicle purchased for the system was powered by two motors, each with a rating of 150 kW, using 600 volts D.C. (Siemens Specifications for Edmonton Light Rail Vehicles, 1977, p. 4) In normal operation, therefore, each vehicle could require approximately 300-400 kW of power. The power required was much greater than that required by individual trolley buses in Edmonton (see Appendix I). Initially, 14 LRT cars were ordered with the intention of augmenting that number at an early date. In order to avoid the spectre of power shortages along the LRT route, a total of 5 substations were planned. With the exception of the substation serving the lines at the Cromdale maintenance facility (the old streetcar barns), the substations were located at approximately 1 mile (1.61 km) intervals. (Edmonton Power Drawing of LRT Positive Feeder System, 1983)

Advances in electronic technologies rendered the mercury arc rectifier an obsolete and expensive means to rectify A.C. Smaller, more efficient and less hazardous solid state rectifier units were selected for the LRT substations. Most solid state rectifiers designed for heavy traction service had a maximum capacity of 1 000 kW. The capacity of each substation was to be 2000 kW so two solid state units were installed in parallel in each substation. (Edmonton Power Drawing of LRT Positive Feeder System) Only one substation was constructed underground during this period. It was located at the Churchill station and it contained 2 Brown Boveri 1 000 kW solid state rectifiers. The three other substations which served the LRT line proper were located near Stadium station, Coliseum station and Belvedere station. Each of these substations contained 2 1 000 kW solid state rectifiers that were manufactured by the British firm of Fosters. (Information from Edmonton Power)

The operation of solid state rectifiers differed from that of mercury arc units. The three phase A.C. supply, as well as the auto and interphase transformers, were still required. The significant difference was with the actual rectifier unit. Instead of using a complex array of anodes and a mercury cathode, solid state rectifiers used 4 large diodes and the necessary auxiliary connections to rectify A.C. (Edmonton Power Schematic Drawings of Solid State Rectifiers, 1983) A solid state diode can be defined as a two-electrode semiconductor that contains a junction of P-type and N-type material. The properties of the adjoining materials are such that they will allow current to flow through the diode in only one direction, from the anode to the cathode. (Handel, 1971, pp. 331-333) Each rectifier unit contains 4 diodes that are connected to the windings of the interphase transformer in such a manner that the output of the rectifier is a constant value of 600 volts. (Edmonton Power Schematic Drawings of Solid State Rectifiers, 1983) The diodes, which are housed in a sheet metal cabinet, require only natural air flow for cooling. The diodes, unlike mercury arc rectifers, generate little heat so that elaborate cooling systems are not required. (Information from Edmonton Power) Although each unit is rated at 1 000 kW capacity, the design of the units enables them to be overloaded 300% for a period not longer than 4 minutes. While most mercury arc rectifiers could be overloaded 200% for brief periods (no longer than 1 minute), they were not as rugged as the solid state rectifiers. (Edmonton Power Specifications of Solid State Rectifiers, 1983)

When the LRT line was extended to the northeast in 1980, an additional substation was constructed near the Clareview station. (Edmonton Power Drawing of LRT Positive Feeder System, 1983) The new substation was equipped with 2 rectifier units of 1 000 kW capacity each which were manufactured by Siemens of Germany. (Information from Edmonton Power) Rectifier installations to this time have been equipped with units of European manufacture. Economic considerations have been the primary reason for this since the Canadian dollar was weak in relation to the American dollar, but was strong compared to most European currencies. European goods were, therefore, significantly cheaper than goods manufactured in North America. Future extensions of the LRT system will require the construction of additional substations which will, most likely, be powered by solid state rectifiers. It should also be remembered that the mercury arc rectifiers serving the trolley bus system are gradually being replaced by solid state units. (See previous section on Electrical Rectification)

LRT Power Distribution, 1977-1980

LRT vehicles, like streetcars, require a track to travel on in addition to a system of D.C. power distribution. The distribution system for the LRT system in Edmonton differs radically from the distribution system that was used for the street railway. A ground return system was used by the street railway in which the current would, ideally, return to the generating station or the substation through the rails or through buried feeder cables. In most instances since the rails were in physical contact with the ground, some current would travel through the ground or through pipes causing serious damage (electrolysis). A semi-floating system of distribution was selected for use on Edmonton's LRT system to prevent electrolysis from occurring.

The rails, whenever possible, were insulated from the ground by means of treated wooden ties or by rubber pads that were placed between the rails and the rail supports. In this manner, there were few opportunities for current to leak from the rails to the ground. In addition, since the rails were not surrounded by pavement, there were few locations where the rails were in physical contact with the ground. Most rail sections as well were joined by thermit welds so there were few locations in the rail where excessive resistance would be encountered. Where angle bar joints were required, at the ends of signal circuits for example, special rail bonds were used to ensure good conductivity between the rail sections. Impedence bonds were used which allowed only certain types of electrical power through them. In this manner, the individual signal circuits could be isolated from one another. The liberal use of negative feeder taps, at least two in each substation territory, and the placement of the substations near the tracks also served to prevent return current from travelling through the ground or through pipes. (Edmonton Power Drawing of Rapid Transit Negative Feeders, 1977) Because the rails were insulated from the ground, a safety device was connected between the rails and the ground. This device, called a potential detector, measured and compared the voltages in the rails and the ground. The purpose of the potential detector was to prevent an electrical hazard from existing between the rails and the ground should a hazardous condition arise. In normal operation, there would be little measurable difference (potential) between the rails and the ground. If, for example, a trolley wire broke and touched the ground, there could be a potential difference between the rails and the ground of up to 600 volts. Anyone who touched both a rail and the ground would complete a circuit between the trolley wire and the rail. The person would, therefore, be electrocuted. The potential detector was designed to prevent this from occurring. If the measured potential difference was about 15 volts D.C. for a period greater than 15 seconds, the detector would sound an alarm in the control centre. If, however, the potential was greater than 45 volts D.C., the detector would cause relays to close which would connect the rails to the ground, thus eliminating a potentially fatal hazard. (Information from Edmonton Power, and Siemens Catalog FM, 1979, § 13 p. 9)

The suspension used for the trolley wire was also significantly different. The street railway and the trolley bus system in Edmonton had used a fixed suspension where the trolley wire was, usually, rigidly supported at set intervals of several feet (metres). The trolley wire could move some distance both laterally and vertically. As the ambient temperature fluctuated, the trolley wire would sag or tighten. With low speed vehicles such as streetcars, these changes in the trolley wire had little effect upon operation. A fixed system used with fast accelerating, high-speed vehicles, such as LRT cars, would cause the current collector either to dewire or to bounce along the wire. The bouncing would cause arcing and, therefore, damage to the collector and to the trolley wire. (Siemens Catalog FM, 1979, § 1 p. 2) For high-speed operation, a type of suspension was required that reduced the effects of temperature change on the wire to a minimum. Such a system, which had been used on many high-speed electric railroads for many years, was known as "catenary" suspension. (Doane & Parkham, 1926, § 18 p. 30) Typical catenary construction, which was installed on the surface portion of Edmonton's LRT system, consisted of a series of steel H columns that were spaced about 55 m apart and which were mounted vertically on reinforced concrete bases usually located between the tracks. The columns, referred to as masts, stood approximately 6 m high. In later construction, the masts were constructed of hollow square steel beams with pre-drilled holes for mounting the necessary suspension hardware. (Information from Edmonton Power) The mast arrangement, similar to street railway centre-pole construction, supported special cantilever brackets on the sides of the masts facing the tracks. In normal application, the horizontal "arm" of the bracket consisted of a galvanized steel cable guy wire insulated from the mast by means of a hinged insulator which held a steel strut tube at a 65° angle from vertical. The strut tube was secured to the mast with another hinged insulator located approximately 1 400 mm below the guy wire. In areas where the overhead assembly would be in compression (on a descending grade for example) the guy wire would be replaced by a steel tube. (Edmonton Power Drawing of Standard Cantilever, 1977) The tops of the strut tubes were fitted with insulators that could secure a stranded copper cable. This uninsulated cable, approximately 13 mm in diameter, was strung along the tops of the strut tubes and was allowed to sag naturally between each bracket. The cable, which was referred to as the messenger wire, followed a catenary curve between support points. The messenger was also strung so that the lowest point of each curve was the same height above the tops of the rails. (Doane & Parkham, 1926, § 18 pp. 31-32) A tubular steel cantilever (supported at one end only) arm was attached to the support tube of each bracket by a hook assembly. These cantilever arms, which had small insulators and clamp ears connected to their free ends, were designed to hold a trolley wire, or contact wire as it was referred to in this application, so that it would not move laterally but could move vertically and longitudinally. The contact wire used was 4/0 Brown and Sharpe gauge, grooved hard-drawn copper wire. It was strung dead along the line. (Information from Edmonton Power) In a manner similar to that used in the installation of the original street railway wire along Jasper Avenue in 1908, the LRT wire was unreeled from a push cart. Instead of using a wooden tower, crews used hydraulically elevated platforms mounted on trucks equipped with flanged wheel attachments in order to connect the wire to the supports. (Author's Photographs and Observations) The contact wire was intended to be supported at a height of approximately 5 m. This was accomplished by attaching the wire to the cantilever arms and by securing the wires, by means of small clamp ears, to thin wire loops attached to the messenger wires. These loops, which were of varying lengths according to the height of the curve, were evenly spaced between support masts and effectively prevented the contact wire from sagging between masts. This arrangement was flexible so the current collector would not bounce as it moved along. (Siemens Catalog FM, 1979, § 1 pp. 2-5) In later construction, the height between the contact wire and the top of the rails was standardized to 5.81 m. This height was thought to provide smoother operation of the current collectors. (Information from Edmonton Power) Figure 31 (after Edmonton Power Drawing of Standard Cantilever, 1977) shows the appearance of a standard cantilever support assembly used in Edmonton. In the initial construction, most of the hardware was supplied by the Swiss Brown Boveri Company. In subsequent construction, both the German Company Siemens and the Swiss Kummler and Matter Company supplied the required hardware. (Information from Edmonton Power) It should be noted that while some of the insulators were made of porcelain, others were composed of cast resins. (Siemens Catalog FM, 1979, § 6 p. 1)

In order for a catenary system to operate successfully, the contact wire had to be divided into sections. Each section was attached to a weighted tensioning device at each end and these tensioning devices were located on masts placed near the sides of the track. The tensioning devices were designed to exert a constant tension on the wire through a system of weights and pulleys. As the ambient temperature rose and the wire expanded, the weights would descend, thereby maintaining the tension and the straightness of the wire. The hinged insulators of the cantilever supports enabled the entire section of wire to move longitudinally. In this manner, the contact wire did not sag or become unnecessarily stretched. A safety feature was incorporated into the tensioning devices. If the contact wire should break for any reason, the weights would naturally attempt to descend quickly. This rapid action could injure people in the vicinity by the falling weights or by the rapid motion of the broken wire. If a break did occur, however, the large pulley of the tensioning device which had ratchet-like teeth along the circumference would fall against a bracket which held a fixed metal bar. The bar would engage the teeth on the pulley, thus preventing the weights from descending. Serious damage, therefore, could be avoided. (Siemens Catalog FM, 1979, § 9 p. 1) The individual sections of contact wire had to overlap in order to prevent power from being cut to the vehicles

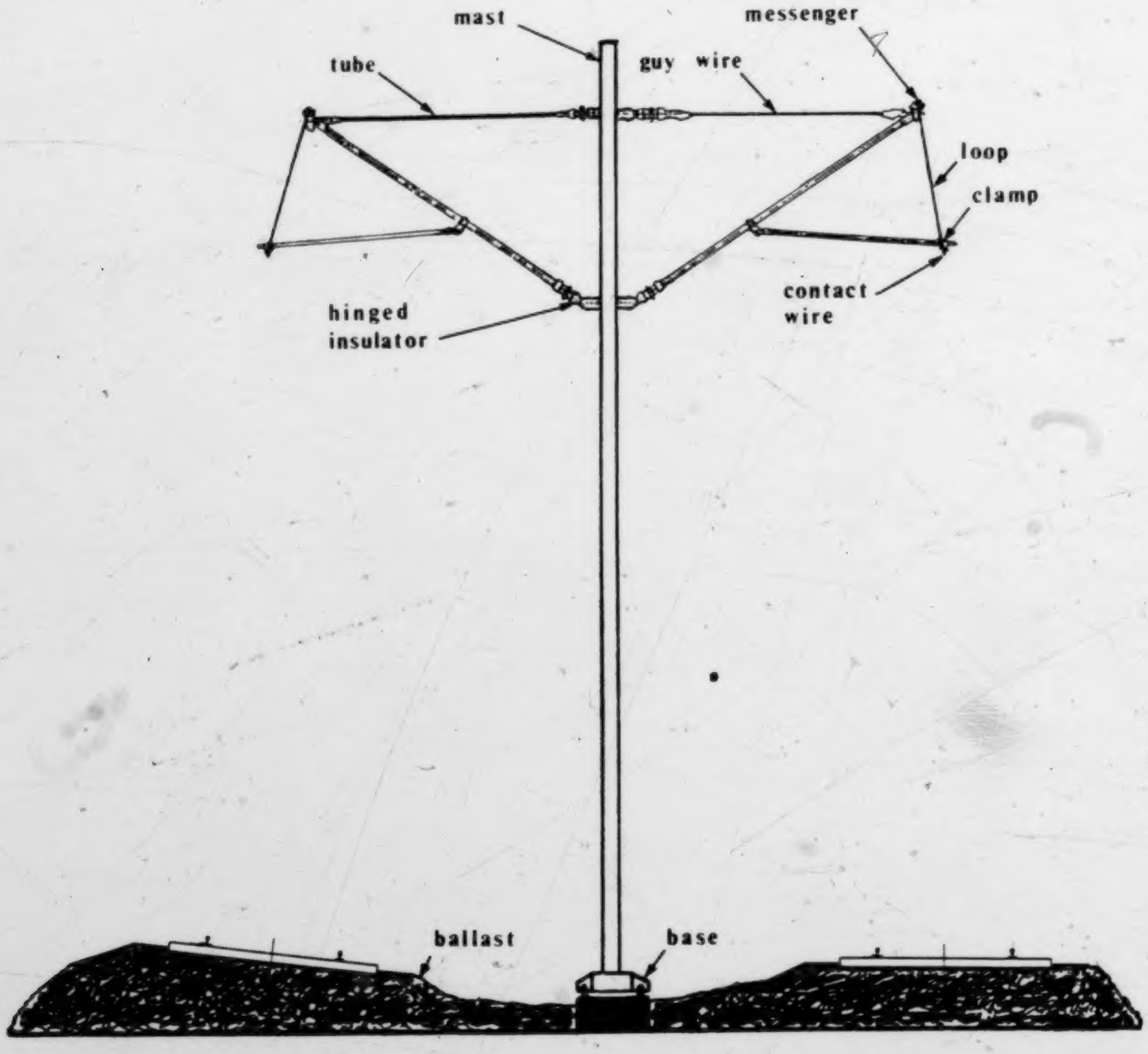

mast
messenger
tube
guy wire
loop
clamp
contact
wire
hinged
insulator
ballast
base

FIGURE 31. CATENARY CANTILEVER SUPPORT

as they passed from one section to another, since the wires were attached to the tensioning devices which were located to the side of the track. In order for this arrangement to be effective, a current collector was required that did not have to follow the path of the wire exactly. The chief disadvantage of both trolley wheels and shoes was that they had to travel along a continuous and smooth surface without jumping off. In high-speed operation, a dewirement could seriously damage either the overhead or the current collector. In addition, special fittings such as electric frogs were required with such collectors. Catenary construction did not lend itself to the use of such current collectors. A wide collector that simply touched the underside of the wire wherever it was placed laterally was what was needed. A common form of this type of collector was known as a pantograph. This device consisted of one or two steel bars arranged perpendicular to the wire in which were placed renewable compressed carbon bars. This comprised the actual current collector. The collector was supported by either one or two tubular frames located on either side of the collector which allowed the collector to be raised and lowered. Springs or air cylinders kept the carbon bars in contact with the contact wire and other springs or air cylinders dropped the pantograph when it was not in use. (Dover, 1929, pp. 203-204) Edmonton selected a half-pantograph for its vehicles. The two carbon bars in this device were supported by a single frame. The contact surface of the device allowed the contact wire to be moved 512 mm to either side of centre. (Siemens Drawing of Halbscherenstromabnehmer "Half-Scissors Current Collector", 1976) In order to prevent a groove from being worn in one portion of the carbon bars, the contact wire was installed so that it wandered laterally between the individual support masts. It is for this reason that the insulators and ears attached to the cantilever arms could be moved along the length of the arm and secured at any point. (Siemens Catalog FM, 1979, § 1, and Information from Edmonton Power)

Underground installations and enclosed stations could not use the traditional catenary construction. Height constraints precluded the use of a messenger wire. In such areas, a specially designed elastic support arm was used to suspend the contact wire. The arm was secured to either the roof or to a steel bracket and was insulated from the same. A pre-set coiled spring inside the arm assembly provided downward thrust on the arm. This arrangement, combined with the tensioning device, enabled the contact wire to be suspended at a constant height while also providing vertical elasticity to the contact wire. Unlike catenary supports, the elastic supports were placed every 8 to 12 m. (Siemens Catalog FM, 1979, § 7) In the initial construction, however, the arms were arranged so that the contact wire travelled straight through, not moving laterally. After several months of operation, it was discovered that these short distances of straight contact wire were wearing large grooves in the half-pantographs' carbon bars. In order to alleviate this problem, crews altered the lengths of the elastic support arms by the addition of varying lengths of fibreglass rod. In this way, the contact wire was deflected laterally through enclosed areas. (Information from Edmonton Power) It should be noted that the catenary hardware manufacturers did produce entire cantilever arms fabricated from fibreglass. These were not used in Edmonton because it was felt that the extreme local temperature fluctuations might cause the fibreglass to fail. Steel tubing, therefore, was used exclusively.

An extensive positive feeder system was installed on the LRT from its beginning. The contact wire was divided into sections no longer than 1 km. Each section was insulated from the other by means of section insulators (sometimes called isolators). These devices, unlike those used on the trolley bus system, employed two fibreglass runners to isolate the sections. In surface areas, the messenger wire acted as the feeder cable. Power was fed into the messenger from the substation at 2 points in each section. (Edmonton Power Drawing of Rapid Transit Positive Circuit Layout, 1977) The messenger, in turn, was connected to the contact wire at least 3 times in the section. The messenger and the contact wires were connected by two loops of stranded copper wire which was similar to the wire used for the messenger. One loop was attached to the messenger by means of clamps while the other loop was attached to the top of the contact wire by means of ears. The two loops were joined with clamps where they touched. This arrangement was designed not to interfere with the vertical flexibility of the contact wire. While some feeding took place through the loops which held the contact wire at the correct height, the loops were not designed to be feeders since their small diameter limited the amount of current they could carry. (Information from Edmonton Power) In underground and enclosed sections, traditional insulated feeder cable and feeder ears were used.

It should be noted that the LRT power distribution system was isolated from the trolley bus power distribution system. At locations where trolley bus lines crossed the LRT system, a special unit of special work was installed in the LRT contact wire. This special work, which consisted of fibreglass supports and shaped copper bars, was suspended from insulated guy wires located above the trolley bus and the LRT lines. The special work was assembled so that the copper bars guided the pantographs down below the level of the trolley bus wires. As the pantographs continued, they engaged other copper bars which carried the pantographs across the trolley bus wires without touching them.

The copper bars were so arranged that they did not interfere with the passing of trolley bus shoes. (Author's Photographs and Observations) In this manner, the two systems were insulated from one another even at points where they crossed. The isolation of one system from the other prevented electrical problems in one from affecting the other.

The LRT system was also protected from lightning and short circuits. Each electrical section was protected by circuit breakers. The entire feeder and rectifier system was also protected by lightning arresters which were located at every substation and at locations where feeder cables reached the masts. (Information from Edmonton Power)

Trolley Bus Power Distribution, 1978-1981

During the mid 1970's, the City purchased some new trolley buses (see Appendix I). The purchase of new rolling stock diminished the likelihood that the system would be abandoned. In order to make the system function more efficiently, the rebuilding and refurbishing of the overhead had to take place. Improvements were also made to the safety of the system. It should be remembered that most street railway crossings of railroad tracks had required the use of National trolley guard. This material, although initially required for trolley bus crossings with railroads, was no longer used. (Author's Photographs) It had been found that the trolley guard did not always provide current to a dewired shoe. In addition, it was possible for a shoe to snag on portions of the trolley guard. The results of this could be disastrous for both the overhead and the trolley bus. (Information from Edmonton Power)

During 1979, a new type of overhead suspension was introduced. It has been mentioned previously that both the street railway and the trolley bus system had used a fixed system of overhead. The major disadvantage of such a system was that as the trolley wires expanded and contracted with changes in the ambient temperature, they would either sag or become extremely rigid. Both conditions were conducive to dewirements. As early as the 1930's, however, the Swiss firm Kummler and Matter (K&M) developed a system of overhead suspension that enabled the trolley wire to move vertically at the suspension points, thus reducing the likelihood of dewirements at those points. (Wittgenstein, 1951, pp. 59-63) A system that imparted vertical flexibility to the trolley wires as well as being able to compensate for the expansion and contraction of the wires due to temperature changes would improve trolley bus operation. The K&M system employed a series of hangers and special ears which were connected by two short lengths of solid wire. The wires were arranged so that a parallelogram was formed between the hanger and the ear. These arrangements, called pendulums, were referred to locally as "trombone hangers". (Information from Edmonton Power) As a shoe passed beneath the ear, the trolley wire could be deflected upwards because of the loose connection between the ear and the hanger. The deflecting trolley wire would tend to tighten as it moved since the parallelogram arrangement forced the trolley wire to the side as well as up. (Modern Trolleybus Overhead Contact Lines, 1983, pp. 4-5) By staggering the direction of the pendulums, the trolley wires would tend to follow a zig-zag pattern. This lateral arrangement of the wires coupled with the action of the pendulums enabled the trolley wire to maintain a constant tension despite changes in the ambient temperature. If, for example, the temperature dropped and the trolley bus wire contracted, the pendulums would be pulled downwards. This action would reduce the length of the trolley wires between the poles (the zig-zag) while maintaining a constant tension on the wires. Figure 32 (after Modern Overhead

Contact Lines, 1983, p. 5 & p. 8) shows the plan and sectional views of a typical K&M overhead installation. It should be noted that the 700 mm spacing of the trolley wires, required to prevent the pendulums from accidentally touching, is somewhat greater than the standard 24 inch (610 mm) trolley wire spacing that was used in previous construction.

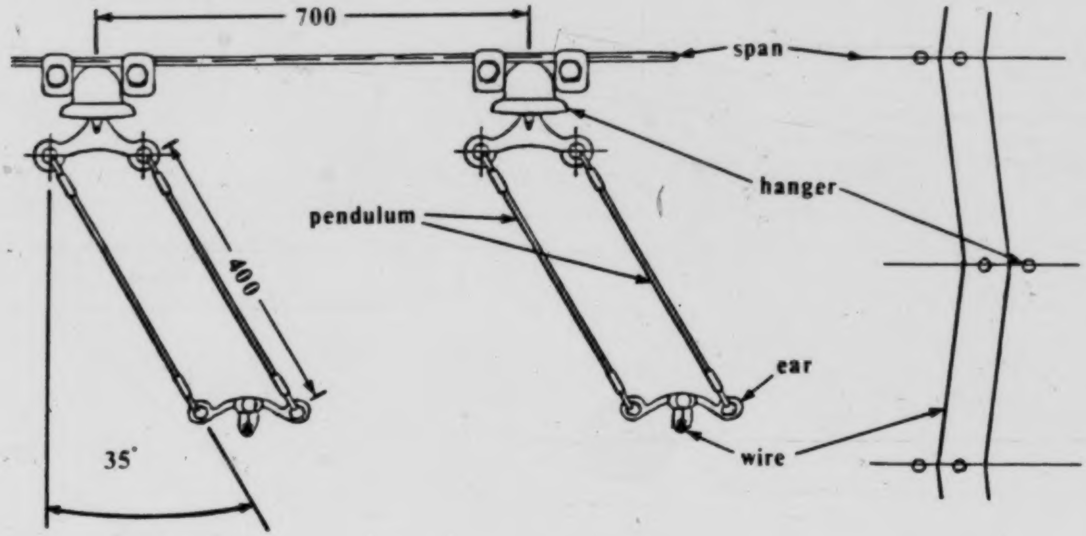


FIGURE 32. SECTION AND PLAN VIEWS OF KUMMLER & MATTER FLEXIBLE SUSPENSION

The K&M system could also be applied to curve segments and to other pieces of special work including section insulators (isolators). (Edmonton Power Drawings of K&M Special Work, 1983) The K&M Company also offered a new type of switch that had been developed during the 1950's.

It should be recalled that the two types of trolley bus switches used in Edmonton to this point required the wires to be fitted into clamps attached to the switch assembly. In order to do this, the trolley wires had to be cut. In addition, the switches were usually suspended by the trolley wires and by steel guy wires fastened to eye lugs cast into the side of the switch assemblies. Much of the longitudinal stress, therefore, was borne by the trolley wires and the switch castings. The switch manufactured by K&M could be installed without cutting the trolley wires. When the trolley wires were installed, they were arranged so that the diverging set of wires were placed on top of the wires travelling straight. The diverging wires, in addition, were extended to the nearest pole where they were fastened to it by strain insulators. The switch frogs and runners were then placed into the wires. Through a system of transition tips (formerly referred to as approach/anchor tips) the diverging set of wires were guided above the main wires. Insulators served to isolate the different polarities of the wires. Elliptically-shaped copper tubes comprised the runners that the shoes travelled along in order to pass from the main set of wires to the diverging set. Figure 33 (after Edmonton Power Drawing of a K&M Electric Switch, 1983) shows the plan view of a K&M switch.

The traditional methods of activating electric frogs, with contactors, were abandoned with the introduction of the new overhead hardware. Radio control units connected to the frog solenoids and to an antenna mounted on the negative trolley wire enabled the operator of a trolley bus to set the switch frogs without slowing down for contactors. A transmitter mounted in the trolley bus which was controlled by the operator could produce two distinct signals. A small antenna mounted near the top of the negative trolley pole emitted the signal that would cause

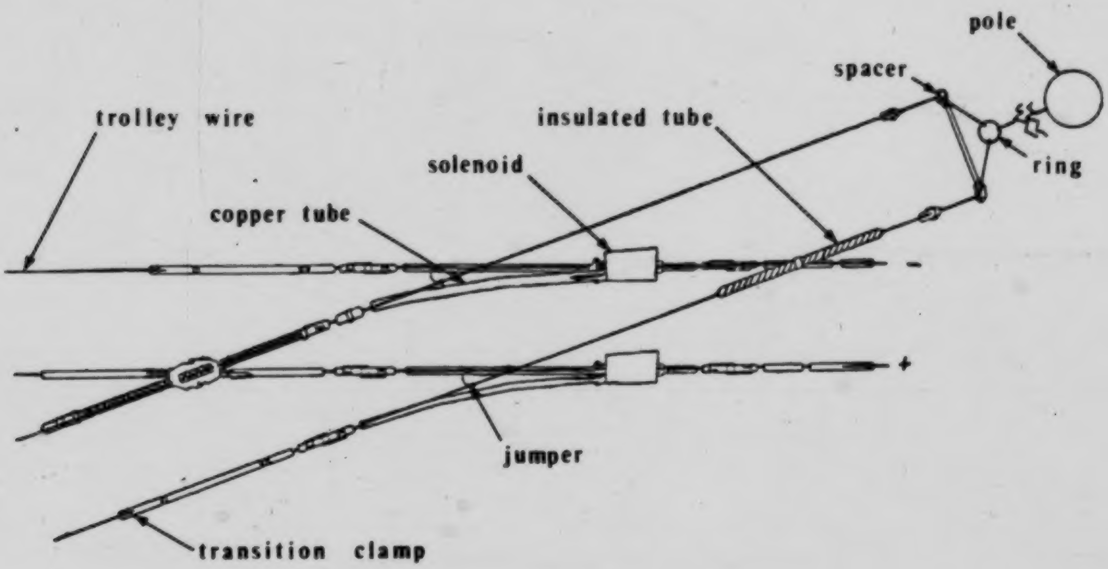

pole
spacer
trolley wire
insulated tube
solenoid
ring
copper tube
-
+
jumper
transition clamp

FIGURE 33. PLAN VIEW OF A K&M SWITCH

the control unit either to maintain the position of the frogs or to switch their alignment. To further assist operators, many switches were equipped with two indicator lights which displayed directional arrows to indicate the alignment of the frogs. The indicator lights were usually placed near the switch, to the left side. (Information from Edmonton Power and Author's Observations)

The use of K&M elastic hardware meant that the positive and negative feeder hangers could no longer be used. Feeder taps reverted to the earlier system of feeder ears connected to the feeder cable by short lengths of insulated cable. This type of feeder tap did not interfere with the vertical movement of the pendulums. (Information from Edmonton Power) Wherever possible, feeder taps were placed an equal distance apart. Feeder taps were placed at approximately every fourth to fifth pole since a standard distance between poles had been introduced. (Information from Edmonton Power)

The introduction of elastic overhead provided crews with an opportunity to install new support poles. Wherever possible, a standard distance of about 33 m was used. (Information from Edmonton Power) In most previous construction, wooden or metal poles were set into holes in the ground and were secured with concrete or tamped earth. If the pole was set incorrectly, moved, was damaged or was no longer required, great expense was involved in replacing it. In order to avoid these problems, a system was devised whereby poles could be bolted to a substantial concrete base. To do this, holes were bored with mechanical augers at the appropriate locations. Steel reinforced concrete was then deposited in the holes in addition to 4 large-diameter studs. A substantial distance of the threaded portion of the studs were left above ground level. After the concrete had hardened, nuts were placed on each stud. Heavy-gauge octagonal steel poles with flanges attached to their bases were then placed on the studs and bolts. An additional set of nuts were used to secure the pole bases to the first set of nuts. By adjusting the two nuts on each stud, the pole could be set at any desired angle, or it could be set plumb in all directions. In addition, the poles were designed to shear from their bases if they were struck severely. (Edmonton Power Drawings of Trolley Pole Slip Base and Anchor Bolt & Reinforcing Cage Assemblies, 1983) During this period, new materials were introduced for span wires. In all previous construction, span wires had consisted of stranded galvanized steel wire. Advances in the technology of plastics enabled manufacturers to produce synthetic span ropes which were not only lighter but were as strong as the steel span wires they replaced.

An additional advantage of synthetic span ropes was that they did not easily conduct electricity so they served as added protection against insulator failure. (K&M Catalog, 1980, p. 9) Improvements were also made to side-bracket construction.

Many new and rebuilt trolley bus lines used side-bracket construction. In the past, the brackets and their guy wires were affixed directly to the poles. A safety hazard existed, however, if metal poles were used. If, for instance, a trolley bus was travelling along a line and its negative pole dewired, it was possible that the pole could strike either a bracket arm or a guy wire. If this occurred, it would be possible that a circuit would form between the trolley bus and ground, the pole being used as part of the circuit. A person leaning against the pole or standing in the immediate vicinity could be electrocuted. In addition, if a tall vehicle were to strike trolley bus wires suspended by side brackets, it would be possible that much of the overhead would collapse because the side-brackets were rigidly connected to their poles. In order to overcome these hazards, a new type of side bracket assembly was designed locally. The bracket was to be insulated from the pole in addition to being made able to swing to either side. The actual bracket arm was insulated from the pole by the use of a hinged insulator similar to the ones used on the LRT catenary. The insulator allowed the assembly to swing should the overhead be struck sideways. The guy wires which supported the bracket arms were insulated from the poles by the use of elliptically-shaped fibreglass strain insulators. (Edmonton Power Drawings of Cantilever Construction, 1983)

Special consideration had to be given to the design of overhead suspension when it was decided to operate trolley buses across the lower deck of the High Level Bridge. The low height on the lower deck precluded the use of elastic overhead as well as traditional span-wire or side-bracket construction. The City, furthermore, was not allowed to drill holes into nor to weld items onto the superstructure of the bridge. (Information from Edmonton Power) A modified fixed system was devised for use on the bridge. Sheets of plywood were attached by clamps to the underside of the upper deck. A corrugated, non-combustible, insulating material was then bolted to the plywood. Small hangers were then bolted through the insulating material and the plywood and the trolley wire was strung. This system worked for a brief time but failed because the longitudinal movement of the bridge sections was greater than the movement of the trolley wires. A modification had to be developed that would enable the bridge to move without damaging the trolley wires. The Edmonton Power engineers accomplished this by attaching the hangers loosely to short lengths of slotted square tubing. With this arrangement, the bridge movements did not affect the tension of the trolley wires. (Information from Edmonton Power)

The upgrading of the trolley bus electrical distribution system that has taken place involved not only the application of new technological systems, but has also required the development of locally-designed hardware to solve unique problems indigenous to Edmonton.

Chapter V

Street Railway Rolling Stock, 1908-1951

Introduction

Although the construction of the street railway in Edmonton had begun in 1907, no rolling stock was ordered until August 1908, at which time the initial construction of the system was nearing completion. As early as September 1907, the City was considering the number and the type of rolling stock to be purchased. At that time, a total of eight large electrically powered passenger cars, each equipped with four 50 H.P. (37 kW) motors, were thought to be required for the track already under construction. (Railway and Marine World, September 1907, p. 683, see Chapter III for the extent and the location of the track constructed during 1907) By the beginning of August 1908, the City of Edmonton had purchased the interests of the Strathcona Radial Tramway Company and had begun to construct a streetcar line to Strathcona. (Railway and Marine World, September 1908, p. 665) This new line was to reach that City, which was situated on the south side of the North Saskatchewan River, by a bridge which was located at the base of the extremely steep grades on either side of the river. (ERR Drawing of Profile of Lines, December 1908)

It would seem that extensions of the street railway trackage would mean that the total number of streetcars required would be greater than the eight originally estimated. The City of Edmonton, however, had a serious shortage of funds at this time so attempts were made to reduce capital expenditures. (Letter from Mayor W. A. Griesbach to "Public Service", October 16, 1907) By the middle of August 1908, it appeared as if the street railway system would be ready for operation by the end of the year. Passenger equipment, therefore, had to be ordered if the street railway was to be able to operate.

Passenger Equipment, 1908

The design of street railway passenger cars was fairly consistent by 1908. Many Canadian cities had electric street railways so Edmonton was not attempting to obtain exotic equipment. Although most of the manufacturers of the track and electrical distribution systems were foreign, there were several well-established manufacturers of streetcars in Canada. The main advantage of Canadian streetcars over American ones was that Canadian built streetcars usually cost less. In addition, Canadian streetcar manufacturers tended to equip their products to better withstand the severe winter weather in this country. (Letter to the City Commissioners from ERR Superintendent C. E. Taylor, March 18, 1910)

The first streetcars for the ERR were ordered in August 1908 from the Ottawa Car Company of Ottawa, Ontario through a local jobbing firm. (Agreement between Gorman, Clancey & Grindley, and the City of Edmonton, August 20, 1908; Ottawa Car Co. Contract for Streetcars, September 3, 1908) A total of seven streetcars were ordered. Six of these were long vehicles which could seat 40 passengers, while the seventh was a shorter car that could seat 32 passengers. (Ottawa Car Co. Specifications for Streetcars, July 31 and August 1, 1908) Despite the estimates of September 1907, the City officials believed that seven streetcars would be able to provide adequate service on the existing lines of the ERR. (Edmonton Journal, August 18, 1908, p. 1)

The type of streetcars that were ordered were known as double-end, semi-convertible cars. The term "double-end" meant that each end of the streetcar was identical and, if the appropriate electrical equipment were installed, it could travel in either direction. The term "semi-convertible" referred to the construction of the streetcar's body. There were three general types of streetcar bodies: open; closed; and semi-convertible. (Doane & Parkham, 1926, § 22 p. 46) Open cars consisted of a frame and a roof supported by several vertical posts. Open cars were designed for summer use and for areas with a warm climate. Closed cars, which were designed for winter use, consisted of a frame, roof and substantial sides which contained a number of small, usually unopenable, windows. Semi-convertible cars were designed for use throughout the seasons. Such car bodies consisted of a frame, roof and sides which contained windows which ran the entire length of the car body. These windows were designed to slide into roof pockets or to drop into pockets in the sides of the body during warm weather. When the weather was cold or was inclement, the windows could be closed. (Doane & Parkham, § 22 pp. 46-47) The ends of the car bodies were strengthened by a framework known as a "bulkhead". Each bulkhead contained a door to enable passengers to enter and leave the streetcar body. The body was usually supported by wheels. In such cases, the floor of the body was too high for passengers to step up to from the street. In order to enable passengers to enter the body easily, platforms or vestibules were placed at each end of the body. The vestibules of the first ERR streetcars consisted of a semi-circular shaped platform which was affixed to the frame of the car body. The floors of the vestibules were set so that they lay several inches (mm) below the floor level of the body. The vestibules were enclosed at the sides and tops and contained several doors and windows that could be opened. (Ottawa Car Co. Specifications for Streetcars, August 1, 1908) Steps located on either side of the vestibules enabled the passengers to enter and exit from the streetcar easily.

The main body frame of the first ERR streetcars, which was rectangular in shape, was composed of wood. Wood had long been used as a construction material for both streetcars and railroad rolling stock. (Cyclopedia of Applied Electricity, Vol. III, 1908, p. 70) The wooden frames were reinforced with steel plates and by a system of metal trusses. The longitudinal parts of the frame consisted of four long wooden beams called sills that were cut to the length of the car body. Two sills, referred to as side sills, formed the long sides of the frame. The two remaining sills, called intermediate sills, were placed several inches (mm) to either side of the centre-line of the frame. The intermediate sills supported the floor of the body as well as bolsters. Bolsters were metal devices which held the trucks to the car body. Georgia pine was used for the sills since that wood could be flexed a certain degree without breaking or cracking. (Ottawa Car Co. Specifications for Streetcars, August 1, 1908, p. 2) The end sills and the cross pieces which held the side and intermediate sills in position, and which were not exposed to much flexing, were formed of white oak. All the pieces of the frame were connected with mortise and tenon joints that were subsequently secured with several 5/8 inch (16 mm) diameter steel bolts that were parallel to the end sills. These bolts, which were spaced along the length of the car body, were designed to be left exposed so that crews could tighten them as the frame joints became loose. The frames of the six longer streetcars measured 20 feet 10 inches (6 350 mm) long by 8 feet (2 438 mm) wide. (Ottawa Car Co. Specifications for Streetcars, August 1, 1908, p. 1) The frame for the shorter streetcar measured 20 feet 10 inches (6 350 mm) long by 8 feet (2 438 mm) wide. (Ottawa Car

Co. Specifications for Streetcar, July 31, 1908, p. 1) Wooden frames of such lengths could not support themselves when heavy weights were placed on them. In order to strengthen the frames, the bottoms of the side sills were reinforced with 5/8 inch (16 mm) thick steel plate which ran along the entire length of the sills. This reinforcing was not sufficient to stop the frame from bending in the middle. In the case of the six longer frames, a system of four longitudinal steel trusses were used to brace the frame. Two of the trusses were mounted on top of the side sills, one on each sill. The truss rods, which ran from one end of the frame to the other, were fabricated from ½ inch (12.7 mm) thick 2 inch (51 mm) wide steel bar stock. The ends of the truss rods were rounded and threaded. Each truss rod rested on two short vertical steel bars called "queen posts" which were fastened to the side sills at the locations where the bolsters would be placed. The ends of the truss rods were bent down so that they passed through holes drilled at an angle through the end sills. By tightening nuts placed on the ends of the truss rods, the side sills were partially braced and were prevented from being bowed upwards by heavy weights in the vestibules. (Ottawa Car Co. Specifications for Streetcars, August 1, 1908, p. 2, and Cyclopedia of Applied Electricity, Vol. III, 1908, p. 70)

To prevent the frame from sagging, truss rods were also placed beneath the frame. In order to strengthen the intermediate sills as well, two 6 inch (152 mm) high steel "I" beams, which were called truss beams or needle beams, were placed across the frame approximately 2 feet (610 mm) on either side of the middle of the frame and were secured to the sills by bolts. Iron castings approximately 1 foot (305 mm) in length were placed on each end of the "I" beams. These castings comprised the queen posts for the bottom truss rods. The rods themselves were fabricated from 1 1/8 inch (27 mm) diameter steel rod. Unlike the upper truss rods, however, the lower rods were flattened at the ends and were bolted to the side sills immediately below the upper truss queen posts. The bottom truss rods were also cut in the middle and each half threaded so that they could be joined by a turnbuckle. The turnbuckle enabled the tension on the lower truss rods to be easily adjusted. (Ottawa Car Co. Specifications of Streetcars, August 1, 1908, p. 2)

The frame for the shorter streetcar also had two upper trusses. The lower trusses were omitted because the frame was to be placed on a single truck which was designed to support the side and the intermediate sills. (Ottawa Car Co. Specifications for Streetcars, July 31, 1908, p. 2)

The fabrication and the installation of the vestibule platforms was the next step of construction. Each vestibule was to be 4 feet 8 inches (1 422 mm) long and was designed to have one semi-circular end. A frame for the vestibules, containing two 7 foot (2 134 mm) long oak sills called "knees", were secured to the body frames' intermediate sills by long steel bolts. Additional shorter knees were secured to the end sills of the body frame also with long bolts. In order to prevent the vestibule from sagging, specially shaped steel plates were bolted to the sides of each knee and to the sills on the body frame. (Ottawa Car Co. Specifications for Streetcars, July 31, 1908, p. 2, and August 1, 1908, p. 3) The ends of the vestibules not attached to the car frames consisted of a semi-circular shaped piece of white oak, called the crown piece, which was bolted to the knees. Six inch (152 mm) wide steel channel, which was shaped to match the curvature of the crown pieces, was then attached to the knees. This channel, known as a bunter, protected the vestibules from damage should the streetcar strike or be struck by another vehicle. The frame was then painted with a white lead compound and the sides and the roof were then constructed.

The sides of the body were first constructed. The six longer streetcars had sides that were framed for ten double-sash windows. The upper portion of each sash was to be small and was to be fixed in position, while the lower portion of the sash was designed to drop into a pocket located between the interior wainscoating and the exterior sheathing. (Ottawa Car Co. Specifications of Streetcars, August 1, 1908, p. 3) The smaller streetcar was framed for eight double-sash windows. (Ottawa Car Co. Specifications of Streetcars, July 31, 1908, p. 3) Each post for the sides were made from white ash. The posts were secured to the side sills by means of pieces of band iron which were held to the posts and the sills with screws and lag bolts. The tops of the posts, which were tenoned, fitted into a mortised white ash sill that was placed on top of the posts and which formed the support for the roof. Belt rails, which provided the sills for the windows, were gained into the posts on each side and were secured with screws. Each belt rail was formed from a single piece of Georgia pine. This was done to prevent water from entering the interior of the sides. Wood braces were then installed diagonally between the belt rails and the body sills. On each side of the car body, at floor level, an 11 inch (279 mm) wide, 1 3/4 inch (44.5 mm) thick British Columbia fir plank was gained into the sides of the posts facing the interior of the car. These planks, called truss planks, provided extra support for the bottoms of the posts. (Ottawa Car Co. Specifications of Streetcars, August 1, 1908, pp. 4-5) The exterior of the car bodies were sheathed with narrow whitewood strips that were placed vertically along the sides and which were nailed to the side framing. Above the windows, a 4 inch (102 mm) high wood strip was placed longitudinally. This strip, called a letter board, finished the exterior of the car between the tops of the windows and the bottom of the roof. The flooring of the cars was tongue and groove pine that was nailed to the frame. Trap doors were placed at locations where crews could easily reach the motors. The centre of the car body floor, however, consisted of a thin piece of hardwood to which was nailed several narrow hardwood strips which were evenly spaced apart and which were the same height as the rest of the flooring. These strips, which ran longitudinally, provided a grooved surface which was designed to prevent passengers from slipping on the flooring if their footwear was wet or icy. The vestibules were constructed in a similar fashion to the car bodies but the vestibules were framed for three windows and for two folding doors. The fronts of the vestibules were sheathed with Number 14 gauge sheet steel. (Ottawa Car Co. Specifications of Streetcars, August 1, 1908, p. 2)

Monitor roofs were applied to these streetcars. The roofs followed a convex curve between the letter boards and a raised central section called a "monitor". A monitor was a clerestory which usually ran along the entire length of the car body on both sides. The monitor, because of its similarity in appearance was named after the iron clad ship of the same name which fought in the American Civil War, contained several small windows along the sides and the ends. The monitor also served as a ventilator since the windows along the sides could be opened. The roof was supported by ash rafters and by 3/8 inch (9.5 mm) diameter steel rods called "carlines". Carlines were formed to the shape of the roof and were placed parallel to the rafters. (Ottawa Car Co. Specifications of Streetcars, August 1, 1908, pp. 4-5, and Cyclopedia of Applied

Electricity, Vol. III, 1908, p. 71) The top of the monitor was arched slightly and had eaves which extended 6 inches (152 mm) over the sides of the monitor. The roofs were sheathed with thin basswood strips which were covered with a white lead compound. The sheathing was covered with Number 10 weight canvas duck. The canvas was nailed to the tops of the letter boards and was then coated with several layers of paint in order to make it waterproof. The roofs of the vestibules, which were called hoods, arched up from the tops of the vestibules and connected to the roof of the car body. Ash rafters supported the hoods and they were sheathed with basswood strips and covered in canvas. It should be noted that the canvas was usually applied to all sections of the roof at a time. (Ottawa Car Co. Specifications of Streetcars, August 1, 1908, p. 5) A wooden framework, which was called a trolley board, was then placed on the roof as support for the trolley pole (current collector). In the case of the longer streetcars, two trolley boards were placed near each end of the monitors. The shorter streetcar required only one trolley board, which was located in the middle of the roof, since the trolley pole would be long enough to be swung around to either end of the car when the direction of travel was to be reversed. (Ottawa Car Co. Specifications of Streetcars, July 31, 1908, p. 6) The interiors of the cars were then finished.

The wainscoating, bulkheads, doors and sashes were all fabricated from Ontario cherry. An additional set of body windows, called storm sashes, were supplied. These storm sashes were designed to be installed on the streetcar's exterior in the winter months in order to reduce heat loss and drafts into the interiors. The interiors of the sashes were covered by roller blinds that were mounted above the sashes. In the vestibules, the bulkhead windows were protected from accidental blows by an arrangement of three brass tubes which were placed horizontally across the sashes near the bottoms. The interiors of the vestibules were finished with cheaper birch wood which was stained to resemble cherry. The ceilings of the car body and the vestibule consisted of a three-ply wood veneer which was finished to resemble bird's-eye maple. (Ottawa Car Co. Specifications of Streetcars, August 1, 1908, pp. 1-6) Before the interiors were completed, however, the cars were wired for interior incandescent lamps, incandescent headlights and electric heaters. In addition, large diameter wires were strung between the trolley boards and the bottoms of the frames via diagonal corners of the body interior. All the wires that were used consisted of a solid copper conductor which was insulated by a rubber coating. (Ottawa Car Co. Specifications of Streetcars, August 1, 1908, p. 7) The interior electric lamps were suspended from fixed sockets which were located in the ceiling. The sockets held clusters of two or three lamps each. Each lamp circuit contained five 110 volt, 40 W incandescent bulbs which were connected in series. It should be remembered that the trolley wire voltage was, ideally, 550 volts. It was, therefore, necessary to use series circuits if ordinary and inexpensive household bulbs were to be used instead of costly high-voltage bulbs. The headlights, one mounted on each end of the streetcar, consisted of a cylindrical iron casting which was secured to the sheet steel sheathing. A mirrored concave glass reflector was placed inside the casting as well as a socket for an incandescent bulb. The bulb and the reflector were protected by a hinged cover which held a glass lens. Wherever possible, the wiring was concealed behind moldings that were easily removeable. (Ottawa Car Co. Specifications of Streetcars, p. 7, and Railway and Marine World, November 1908, p. 315)

The electric heaters that were installed consisted of a number of hollow porcelain tubes on which were wrapped coils of spirally-wound resistance wire. When trolley voltage was applied to the heaters, the wire would produce large amounts of heat. The heaters were housed in perforated metal boxes in order for natural air flow to distribute the heat. (Doane & Parkham, 1926, § 22 pp. 28-29) A total of fourteen cross-seat heaters were installed in each of the six longer streetcars. These heaters were mounted on the floor directly under the seats. Ten cross-seat heaters were installed on the shorter streetcar. (Ottawa Car Co. Contract for Streetcars, September 3, 1908, pp. 2-3)

Before the seats were installed, the interiors were sanded and varnished. In addition, a cord was strung along the entire length of each interior. Each end of the cord, which passed through holes drilled through the tops of the bulkheads, was connected to a small hammer gong assembly that was mounted on the ceiling of each vestibule. These gongs, usually about 4 inches (102 mm) in diameter and which were of brass or bronze castings, were rung each time the cord was pulled. (Artifacts and Photographs in Author's Collection) In this manner, passengers could signal the motorman or the conductor when they wished the streetcar to stop. The manufacturer's name as well as the car number were then painted in gold letters on the car body panels above the bulkhead doors.

The seats that were installed on the first ERR streetcars were of the cross-seat, reversible type. The term "cross-seat" meant that the seats were mounted across the interior of the car. A reversible seat employed a cast iron frame and a moveable seat cushion and seat back. The seat cushion and seat back could be moved by means of a brass handle on the seat back so that the seat could face the direction of streetcar travel. The seat backs and cushions were upholstered with woven rattan strips, sometimes referred to as "cane" or "wicker". The seat backs were stuffed with horsehair while the cushions contained an array of spiral springs. A total of twenty cross-seats were installed in each of the long streetcars. Sixteen were installed in the shorter streetcar. With the exception of the four seats in each corner, the reversible seats were arranged so that they were placed against the sides of the body but beneath the centre of a window. This arrangement created an aisle down the centre of the car body. The four corner seats were not reversible and they were attached to the walls. Each seat cushion was approximately 34 inches (864 mm) wide and could accommodate two passengers. The six longer streetcars, therefore, could seat forty passengers while the shorter streetcar could seat only thirty-two passengers. (Ottawa Car Co. Specifications of Streetcars, August 1, 1908, p. 2 & p. 6, and July 31, 1908, p. 5)

A 12 inch (305 mm) diameter steel gong was placed beneath the floor of each vestibule. A steel plunger, which passed through the floor, could push a weighted hammer which struck the gong. The gong was to be used for warning pedestrians and motorists as well as for signalling. Two gravity-feed sanders were also installed on each streetcar. Each sander, which consisted of a wooden bin located underneath the fixed corner seat to the left of the motorman, was designed to deposit a quantity of sand on the left-hand rail immediately in front of the wheel when the motorman pushed a foot plunger. This plunger moved a series of rods and levers which opened a hatch at the bottom of the sand bin. Sand would fall from the bin and would be guided to the rail by a short length of pipe. The sand improved the adhesion of the wheel against the rail. (Ottawa Car Co. Contract for Streetcars, September 3, 1908, pp. 1-2) The streetcar was now ready to be placed onto trucks.

The car bodies, in order to travel along the rails, had to be mounted onto one or more sets of wheels called "trucks". Doane and Parkham (1926) define a truck as "a set of wheels in a framework designed to support the whole or part of the weight of a car body and equipment" (§ 22 p. 49). Two general types of trucks could be used on streetcars, single or rigid trucks, or swivel trucks. A single truck consisted of a steel framework that was rigidly attached to the car body frame which also held two axles a certain distance apart. Swivel trucks, usually mounted in pairs, consisted of a steel framework that held the two axles a certain distance apart. The entire truck framework, however, was designed to swivel beneath the car body on a fixed point. In this way, long streetcars could negotiate sharp curves. Single trucks were rarely used on streetcars with body lengths greater than 22 feet (6 706 mm) because the wheel base (distance between the axles) required to support properly longer streetcars would not allow the truck to negotiate tight curves. (Doane & Parkham, § 22 p. 47) It is for this reason that only the shorter streetcar was equipped with a single truck. It is important to note that this streetcar, ERR Number 7, was the only single truck passenger streetcar that was operated on the system (see Appendix I).

Most Canadian streetcar builders did not have the equipment that was necessary to manufacture streetcar trucks. Trucks were purchased from either large American streetcar builders or from steel foundries. The Ottawa Car Company, at that time, generally purchased trucks from the J. G. Brill Company of Philadelphia, Pennsylvania. Brill was a large American streetcar builder.

It was mentioned previously that the six longer streetcars had provision for two bolsters under the body frame. Bolsters were necessary for placing the car body on the swivel trucks. The bolsters used for these streetcars were fabricated from two heavy steel plates, each

9 inches (229 mm) in width. One plate, 3/4 inches (19 mm) thick which extended across the middle of the body frame, was flat and was bolted to the frame. The second plate, 7/8 inches (22.5 mm) thick, which was bent downwards in the middle, was bolted to the first plate at the ends. Small steel blocks kept the two plates a set distance apart. The central portion of the second plate was shaped so that it lay parallel to the first plate. This type of bolster was known as a "diamond pattern" bolster. (Ottawa Car Co. Specifications of Streetcars, August 1, 1908, p. 2) A forged steel bearing plate, which was called a centre-plate, was bolted to the centre of the lower bolster plate with four large bolts. The centre-plate was formed so that it held, vertically, a length of 1 3/4 inch (44.5 mm) diameter hardened steel rod which was called a "kingpin". The kingpins were approximately 6 to 10 inches (152 to 254 mm) in length and were designed to fit into corresponding holes in centre-plates which were bolted to the centre of each truck. The kingpin and centre-plate assembly held the truck in position on the bolster while allowing the truck to swivel without damaging the bolster or the underside of the car body. (ERR Drawings of Centre-Plate Assemblies) Additional bearing plates were located on the bolsters to either side of the kingpin. These bearing plates prevented the car body from rocking sideways a great distance. (ERR Drawings of Side Bearing Plates)

The trucks that were selected for these streetcars were Brill type 27-G-1 with a 4 foot 6 inch (1 372 mm) wheelbase. (Ottawa Car Co. Contract for Streetcars, September 3, 1908, p. 2) The normal wheelbase of a 27-G-1 truck was only 4 feet (1 129 mm). Longer than normal sideframes, therefore, were required to extend the trucks' wheelbase. The designation of the longer wheelbase Brill trucks was 27-GE-1. (Brill Drawings and Specifications of 27-G-1 and 27-GE-1 trucks, and Brill

Photograph 4800, showing a 27-GE-1 truck for the ERR) The steel sideframes held the axles in position. The axles, to which the wheels were pressed, rested against brass bearing plates which were held in moveable cast iron cases called journal boxes. The bearings were lubricated by filling the lower portion of the journal box with oil and with a cotton fibre wick called "waste". The wheels that were applied to the first ERR streetcars were 33 inch (838 mm) diameter cast iron. (CECR No. 143, December 28, 1909) The wheels were cast so that the rim was supported by six evenly-spaced spokes. The wheels were turned on a metal lathe so that the flanges and edges of the wheel were concentric. The sideframes did not rest on the journal boxes directly. Four coiled springs were placed between the top of each journal box and pockets in the sideframes. Additional coil and leaf springs separated the sideframes from the truck bolsters. A truck bolster was a steel beam on which the streetcar rested. The springs were so arranged that each wheel could undulate vertically without affecting the vertical motion of the other wheels. In addition, the springs absorbed much of the bumping of the wheels along the rail surface, thus providing a smoother ride for the passengers. The sideframes were held at the correct distance apart by shaped steel angle bars which were bolted across the ends of each sideframe. These angle bars, through an arrangement of coiled springs, supported a vertically aligned flat steel bar that was designed to allow an electric motor to be bolted to it. Each truck, therefore, could support two motors. The motors had to be placed near the ends of the truck since there was insufficient room for them between the axles and the truck bolster. This motor placement was referred to as "outside-hung". (Brill Co. Specifications of 27-GE-1 Truck)

There was a disadvantage to trucks with outside-hung motors. If the speed of the streetcar was to exceed 30 miles per hour (48.3 km/h), the trucks would tend to oscillate vertically. If a great enough speed was achieved or if the track was in poor alignment, the trucks would derail. Most streetcars in urban service would rarely travel at speeds greater than 30 miles per hour (48.3 km/h) so most short wheelbase streetcar trucks used outside suspension. (Brill Co. Specifications of 27-GE-1 Truck) The Ottawa Car Company did not supply the electric motors for these ERR streetcars so the trucks were installed without motors. (Ottawa Car Co. Contract for Streetcars, September 3, 1908, p. 2)

The shorter streetcar (Number 7) was equipped with one Brill 21-E single truck which had a wheelbase of 8 feet (2 438 mm). (Ottawa Car Co. Specifications of Streetcar, July 31, 1908, p. 1) The sideframes of the 21-E truck not only supported the journal boxes but, through a series of coiled and leaf springs, they supported long steel bars on each side that were bolted to the side sills of the car body. The weight of the car body was transferred to the truck through the side sills. The truck, which was securely cross-braced with steel bars, prevented the car body from sagging in the middle. The long wheelbase of the 21-E truck enabled the hanger bars (yokes) for the motors to be placed between the axles. The motors, therefore, were inside hung. The inside suspension of the motors contributed to the stability of the streetcar. An additional feature of the 21-E truck that was not found on the 27-GE-1 truck was a lifeguard (sometimes called a fender) at each end of the truck. A lifeguard was a device that prevented a large object, specifically a human being, from being run over by the wheels. The lifeguards on the 21-E truck consisted of two steel castings that were bolted to the sides of the sideframes at each end of the truck. A large board was then bolted across the ends of the castings. The board, which was placed so that it was only a few inches (mm) above the level of the tracks, prevented large objects from being run over since such objects tended to be pushed along by the board. (Brill Co. Specifications of 21-E truck, 1908) A different type of lifeguard was used on streetcars which had swivel trucks. It will be discussed later in this section.

Following the installation of the trucks, the streetcars were fitted with handbrakes. These brakes were to be the streetcars' main braking system. Although air brakes were being used on other street railways, they were expensive and were thought not to be necessary for the ERR. The single truck car, in addition, had no room beneath it for air brake apparatus. The handbrake system consisted of chains, rods, levers and winding shafts which exerted tension on brake shoe levers which pulled metal brake shoes against the sides of the wheels. The friction between the wheels and the brake shoes slowed or stopped the streetcar. A large, vertically-mounted shaft was placed in the front of each vestibule. The top of the shaft had a bronze handle which could be rotated in either direction. The handle, by means of a ratchet arrangement, would not turn the shaft when it was rotated counter-clockwise. A large ratchet gear was placed on the shaft immediately above the point where the shaft passed through the vestibule floor. A large pawl lever, which was called a "dog", was bolted to the floor a short distance away. The motorman could, with his foot, hold the dog against the ratchet gear. When this was done, the shaft could rotate in a clockwise direction only, thus applying and holding the brakes in the "on" position. By pushing the dog away from the gear, the motorman would allow the shaft to rotate counter-clockwise, releasing the brakes. A length of chain was bolted to a spiral-shaped casting which was attached to the shaft below the vestibule floor. The chain, in turn, was attached to a steel bar which was connected to a large steel lever which was bolted to one of the intermediate sills near the centre of the car body. The lever, which pivoted in the middle, was attached to two other steel bars which were connected to the brake rigging of the trucks. When the motorman wound the shaft in a clockwise direction, the chain would wrap around the spiral casting on the shaft. This action would pull the lever. The action of the lever would be transmitted to the brake rigging on the truck. The brake shoes would be pulled against the sides of the wheels with great pressure because of the lever action. The streetcar could, therefore, be slowed or stopped by the actions of one man. (ERR Drawings of Brake Gear, 1908-1910, and Cyclopedia of Applied Electricity, Vol. III, 1908, pp. 53-56) The brake shoes, made of cast iron, conformed to the radius and to the flanges of the wheels. The shoes were designed to be pressed against the sides of the wheels as well as against the sides of the flanges. (ERR Drawings of Brake Shoe Patterns, 1910-1931) Considerable noise was generated by the metal shoes rubbing against the metal wheels when the brakes were applied. Brake shoe noise was a common complaint of some of the citizens against streetcar operation.

Additional external hardware was applied to the streetcars before they were shipped. Steps were attached to the bottom of each vestibule below the doors. A single step was provided. Each step consisted of formed malleable iron hangers and risers. The treads were made from 1 ¼ inch (31.8 mm) thick birch or maple planks which were bolted to the hangers. (Ottawa Car Co. Specifications of Streetcars, August 1, 1908, p. 3) The height of the step, measured from the top of the rail, was approximately 16 inches (406 mm). (ERR Specifications of Streetcars, 1913) In order to assist passengers entering the streetcars, vertical grab handles were placed on either side of the vestibule doors. These handles consisted of 1 1/8 inch (29 mm) diameter white oak or hickory dowels which were about 30 inches (762 mm) in length. Bronze fittings, which were held to the sides of the streetcars with screws, held the dowels vertically and a short distance away from the sides. In addition, at diagonal corners of the body, several small cast iron steps were secured to the posts. These steps enabled ERR personnel to climb onto the roof of the car. (Ottawa Car Co. Specifications of Streetcars, August 1, 1908, pp. 6-7)

Below each vestibule floor was attached a spring-buffered draw bar which had a link and pin coupler box. These steel draw bars were fixed to one pivot point on the vestibule's centre knee. A heavy coiled spring connected the draw bar to the pivot point. A steel guide rail which was bolted to the vestibule crown piece held the draw bar horizontal. The exposed end of each draw bar consisted of a steel box which had a vertical hole through it. A steel pin was placed through this hole. The pin held a large steel link which was inserted into the end of the box and which could be connected to another draw bar. By this arrangement, a streetcar could be pulled by another vehicle. (Ottawa Car Co. Specifications of Streetcars, August 1, 1908, p. 7)

When all the necessary hardware had been installed, the exterior of the streetcars could be painted and lettered. Several coats of linseed oil primer were first applied. Colored oil-base paints were then brushed onto various parts of the exterior. Although the Contract for these cars does not specify what the colors were, a press report written on the day that the first streetcar arrived in Edmonton stated that they were "green in color, with natural wood trimmings and on each side the words in gold, 'Edmonton Radial Railway'" (Edmonton Bulletin, October

29, 1908, p. 8). The green portions appear to have been the sections of the vestibule and carbody below the belt rails. It is likely that the trucks, underframes and the canvas on the roofs were all painted black.

After two coats of colored paint were applied, the lettering and the numbering was applied to the exteriors. The numbers, which were applied on either side of the name, were also applied to the dash (the front portion of the vestibule) on either side of the headlight. When the lettering was complete, three coats of varnish were applied over the exterior to prevent the paint and lettering from suffering the effects of weather. (Ottawa Car Co. Specifications of Streetcars, August 1, 1908, p. 7) At this juncture, the streetcars could be pushed up an inclined ramp and onto railroad flat cars where they would be secured, covered and then transported to Edmonton. Plate 18 (Public Archives of Canada, PA-137800) shows the external appearance of ERR streetcar Number 2 at the Ottawa Car Company plant in October, 1908 immediately before it was sent to Edmonton. The trucks, truss rods, steps, brake handle, storm sashes, monitor and the trolley boards should all be noted. Plate 19 (Public Archives of Canada, PA-137799) shows the interior appearance of Number 2 after its construction was complete. The reversible cross-seats, monitor sash openers, grooved flooring and the sliding bulkhead door should all be noted. Plate 20 (Public Archives of Canada, PA-137802) shows the external appearance of the single truck streetcar Number 7 at the Ottawa Car Company plant in November before it was sent to Edmonton. The lifeguards, draw bars, grab handles, single trolley board and the wire protruding from the bottom near the right-hand step should all be noted.

Number 2 was the first streetcar to arrive in Edmonton. Although both 1 and 2 left the plant at the same time, each was transported by

Plate 18. (Public Archives of Canada) Streetcar Number 2
At Ottawa Car Company, 1908

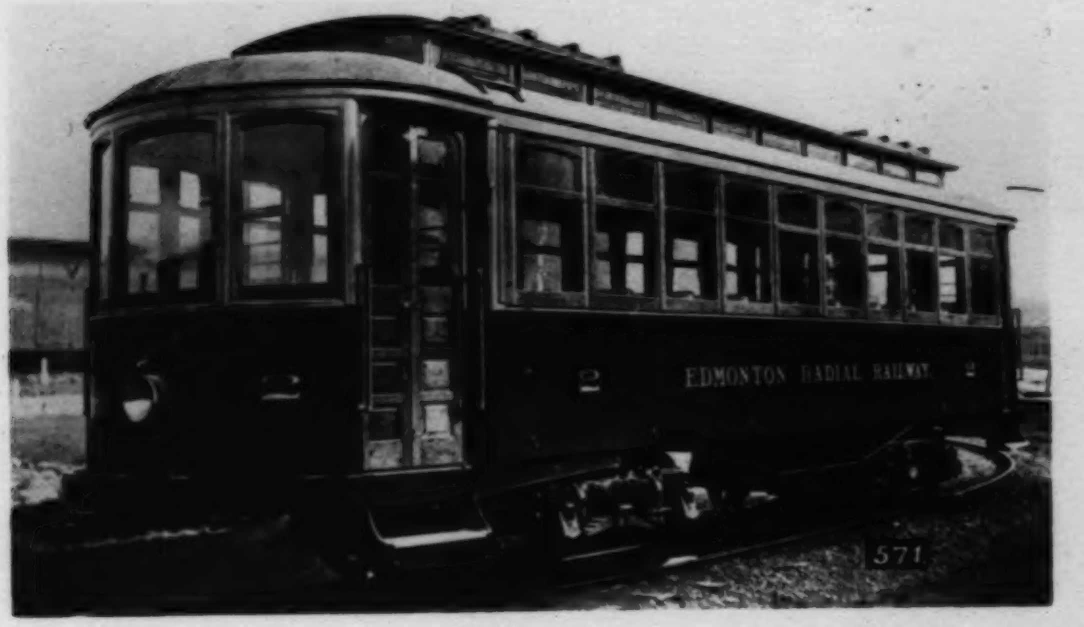

EDMONTON RADIAL RAILWAY
2
571

Plate 19. (Public Archives of Canada) Interior of Streetcar Number 2
At Ottawa Car Company, 1908

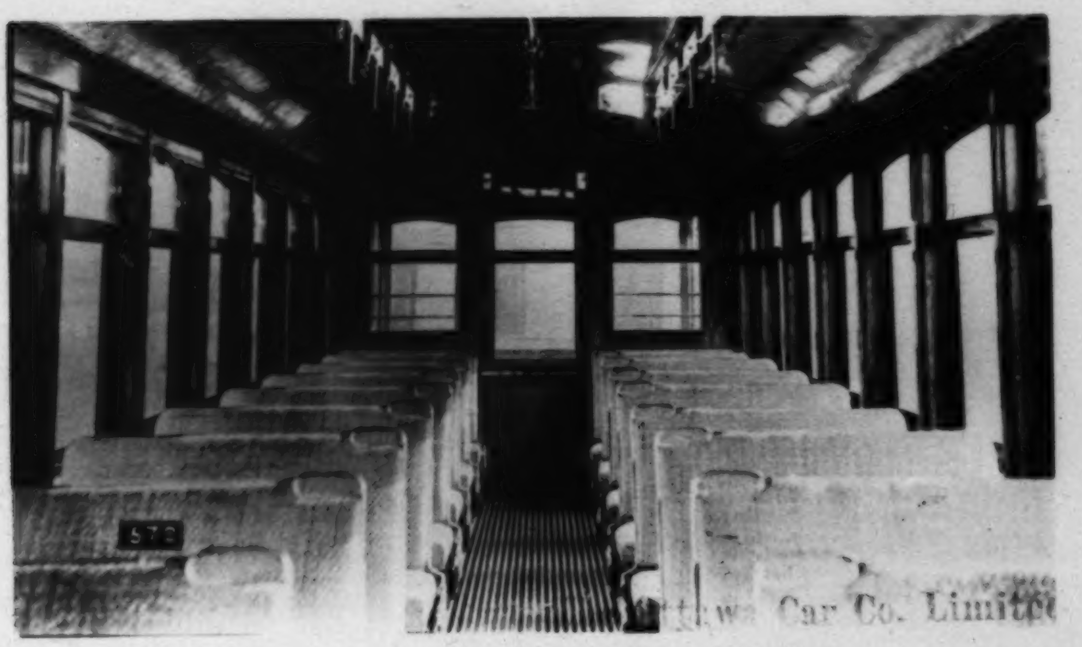

572
Ottawa Car Co. Limited

Plate 20. (Public Archives of Canada) Streetcar Number 7
At Ottawa Car Company, 1908

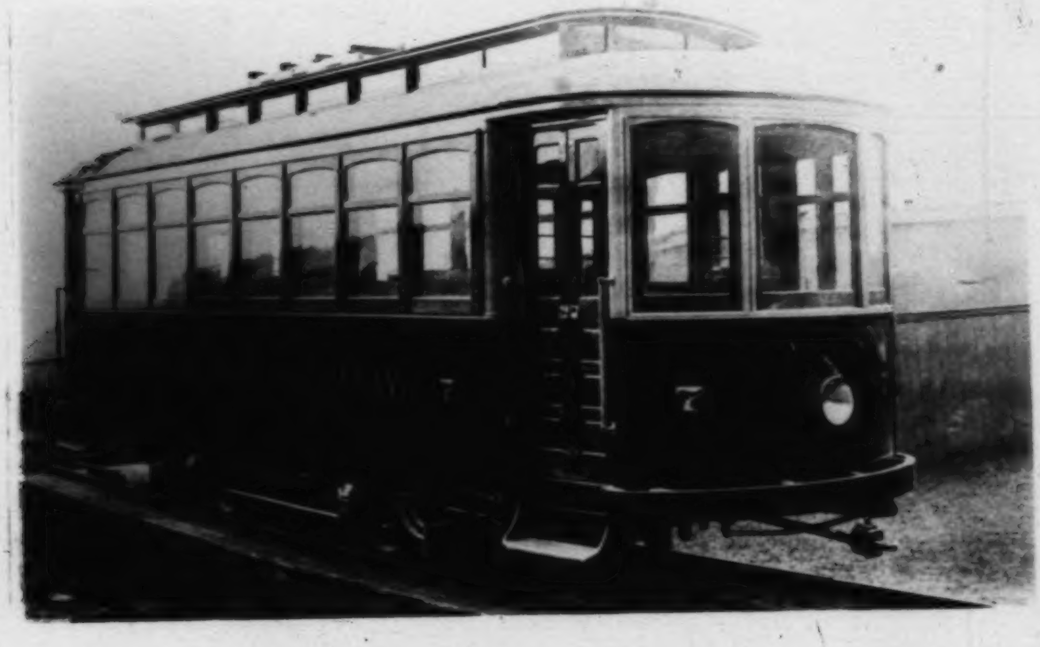
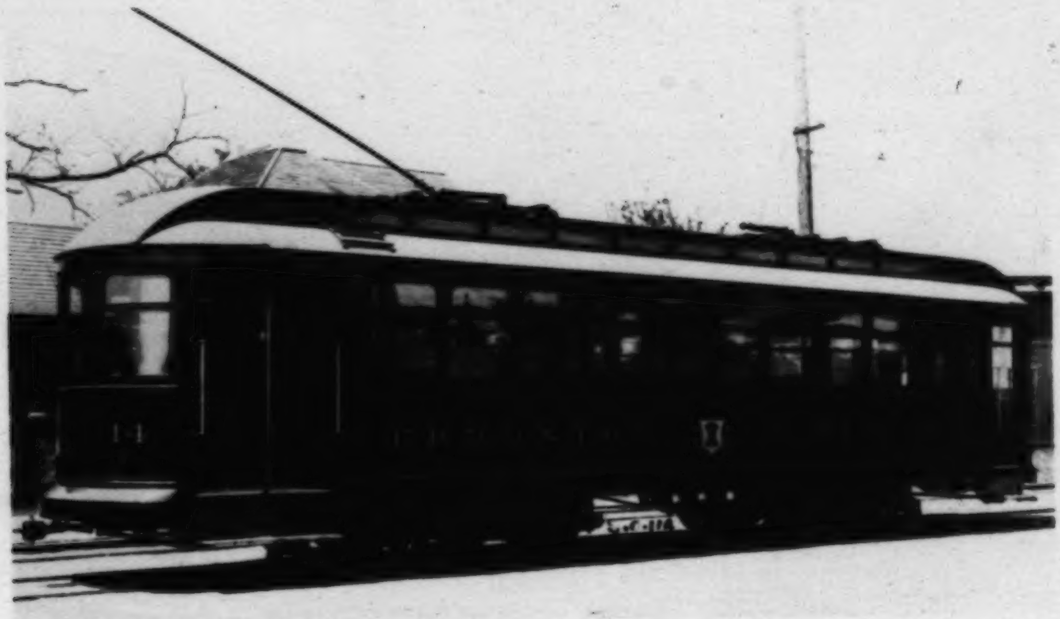


Plate 21. (Public Archives of Canada) Streetcar Number 14
In Preston, Ontario, 1909



a different railroad. The railroad that delivered a streetcar first would obtain a contract for transporting the other five. Number 2, which the CPR had been transporting, arrived in Edmonton on October 24, 1908. (Edmonton Journal, October 20, 1908, p. 1, October 22, 1908, p. 1, and October 24, 1908, p. 4) Number 1, which had been transported by the Canadian Northern Railway, did not arrive in Edmonton until October 31. (Edmonton Journal, October 31, 1908, p. 1) The remaining five streetcars arrived in Edmonton before the end of December (see Appendix I).

Before Number 2 or any of the other streetcars could be placed in service, electric motors and their control apparatus had to be installed. About the same time that the streetcars had been ordered, the City had ordered the necessary motor and control equipment from the Canadian General Electric Company of Peterborough, Ontario. The equipment was to be delivered to Edmonton. Four motors were to be installed on each of the six longer streetcars while two motors were to be installed on streetcar Number 7. The motors that were selected were designated GE-80A-1. These motors had a rating of 40 H.P. (29.8 kW) and were designed for heavy-duty use. (CGE Contract for Motors and Equipment, August 18, 1908) The GE-80A motor consisted of a split cast iron case or frame, the lower half of which could be opened for maintenance purposes. The motor also included a number of field coils which were bolted to the interior of the case. A large armature which was supported by oil-lubricated babbit bearings was also housed in the case. The case was shaped so that one end of it slid onto an axle of a streetcar truck. Babbit metal sleeve bearings which were lubricated from oil reservoirs in the case protected both the axle and the motor case from wear. The other end of the case was bolted to the spring-supported motor hangers on the truck. Figure 34 (after General Electric Co. Drawing No. 14182, May 1905) shows the plan and end views of a GE-80A motor, outside-mounted on a streetcar truck. Minor deletions and additions were made by the author.

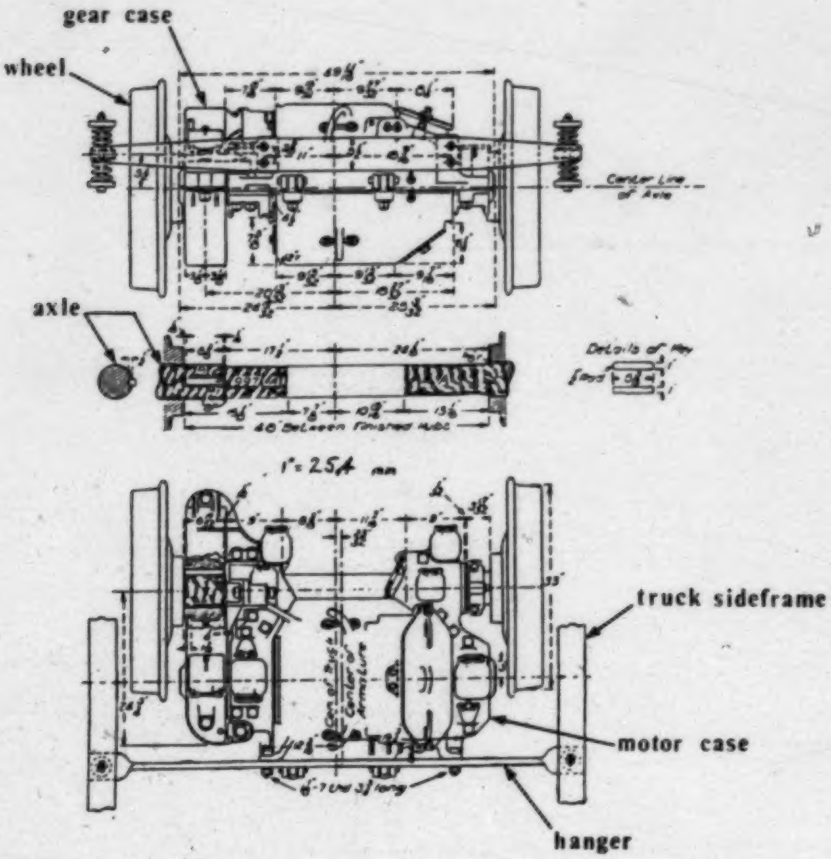

gear case
wheel
Center Line of Axle
axle
Details of Key
40" Between Finished Hubs
1" = 25.4 mm
Center of Armature
truck sideframe
motor case
hanger

FIGURE 34. OUTSIDE HUNG GE-80A MOTOR,
END AND PLAN VIEWS

The torque of the motor was transmitted to the axle through two spur gears. A small diameter pinion gear was pushed onto the end of the motor's armature shaft and was held on by a nut which was placed on the shaft. A rectangular steel key placed in a notch in the gear and into a corresponding keyway in the armature shaft prevented the gear from rotating independently of the armature. A large diameter gear, which was split in half, was bolted and keyed onto the axle of the truck. A split gear was easier to install, align and remove than a solid gear. Both gears were lubricated with grease and were enclosed in a pressed steel cover. (General Electric Co. Bulletin 4421, January 1907, pp. 5-6) Figure 34 shows the gear cover and axle keyway for a GE-80A motor. The gears, which each had a 5 inch (127 mm) face, were manufactured in a variety of size ratios. The appropriate ratio was selected from a number of tables which plotted motor efficiency against speed and tractive effort for each available ratio. For most urban applications where the maximum speed was unlikely to exceed 30 miles per hour (48.3 km/h), a gear ratio of 69 to 17 was recommended. The pinion gear possessed 17 teeth while the large split gear possessed 69 teeth. General Electric motors that used a gear ratio of 69 to 17 had the suffix 1 added to their designations, hence GE-80A-1. (General Electric Co. Bulletin 4421, January 1907, pp. 6-15) Forty H.P. (29.8 kW) motors were considered to be powerful enough to move the streetcars along the grades found on the ERR in 1908. It should be noted that when the streetcars were in operation, a whine could be heard from the vicinity of the trucks. This noise was caused by the successive meshing of the gear teeth and was a distinctive feature of spur gears.

Power for the motors had to be collected, regulated and controlled on the streetcar. Current was drawn from the trolley wire by means of a trolley wheel. A trolley wheel was usually about 4 inches (102 mm) in diameter and was made of cast phosphor bronze. The wheel was shaped so that a large groove was formed around the circumference in the middle. The wheel was mounted on a small steel axle which was held in a U-shaped iron casting called a "harp". The harp allowed the trolley wheel to rotate freely on its axle. A short length of steel rod attached to the bottom of the harp enabled it to be inserted into a tapered steel tube called a trolley pole. Trolley poles, which ranged in length from 12 to 14 feet (3 658 to 4 267 mm), were bolted to a steel swivel base that was attached to the trolley board of a streetcar. These swivel bases were known as "trolley bases" and they consisted of three main parts: the fixed base, which was bolted to the trolley board and which held the rest of the assembly; the spring base, which swiveled around a pivot on the fixed base and which held two or four springs; and the foot. The foot, which was attached to the spring base, could pivot up and down. It was also attached to the other end of the springs that were attached to the spring base. The foot also gripped the thick end of the trolley pole. (Doane & Parkham, 1926, § 22 pp. 4-7) The action of the springs caused the trolley pole to be pulled upwards. The trolley wheel, therefore, ran along the underside of the trolley wire. The groove in the trolley wheel kept it from easily slipping off the underside of the wire. A rope attached to the harp enabled the trolley pole to be pulled down. When it was not in use, a steel hook which was attached to the trolley board, held the trolley pole horizontal. The springs on the trolley base could be adjusted so that the pressure of the wheel against the wire would be between 20 and 40 pounds (9 to 18 kg), which was the recommended range for trolley wheel pressure on the wire. The spring trolley bases did not allow a streetcar to travel in both directions without changing the direction of the pole. In normal operation, the pole trailed behind the streetcar. If, however, the streetcar were to travel in the opposite direction, the trolley pole would be leading. The forces acting against the trolley wheel, when the trolley pole was leading, combined with the pull of the springs, could cause the trolley wheel to snag on special work or on ears. The result would be a bent or broken trolley pole. It is for this reason that double-end streetcars either had a pole at each end or, if the car were short enough, one pole that could be swiveled from one end of the car to the other. (Doane & Parkham, § 22 p. 7)

The current, after travelling through the trolley wheel, harp and base, entered a large copper cable that was connected to the fixed base, and which led into the vestibule of the streetcar at the opposite end to where the pole was located. A smaller wire was connected to the larger cable at the point where the larger cable entered the streetcar. The smaller wire travelled to the bottom of the frame where a lightning arrester was located. The ground wire from the lightning arrester was connected to the case of the nearest motor. The operation of lightning arresters was described in the previous chapter. Immediately before the large cable entered the streetcar's vestibule, the cable was coiled around a large diameter wooden dowel for several turns. These coils, which were referred to as "chokes" or "kicking coils", acted as inductors and tended to prevent extreme current surges such as lightning from travelling through the large cable rather than through the lightning arrester. (Cyclopedia of Applied Electricity, Vol. III, 1908, pp. 41-42) A circuit breaker, or a fuse box in the case of streetcar Number 7, was then placed in the circuit. The circuit breaker or the fuse box was mounted on the interior ceiling of the vestibule. The circuit breakers were occasionally referred to as "hood switches" since the roof of the vestibule was often called a hood. Both units possessed a wooden handle that protruded from the bottom of the cabinet. The handle was attached to a moveable contact that could open (break) the circuit. The circuit breakers, which functioned in a manner similar to those described in the previous chapter, would allow a maximum of 300 Amperes at 550 volts D.C., or 165 kW of power to pass through the circuit without tripping. The fuse on car Number 7, however, allowed only 150 Amperes at 550 volts D.C., or 82.5 kW of power through the circuit before the fuse element melted and broke the circuit. (CGE Contract for Motors and Equipment, August 18, 1908)

A circuit breaker was installed in each of the vestibules of double-ended streetcars. Circuit breakers were not sufficient to control the power reaching the motors. If full trolley voltage was applied at once to the motors, the extreme and sudden torque could destroy the gears as well as throw the passengers about who were inside the streetcar. Therefore, a device was inserted between the circuit breaker and the motors which controlled the voltage reaching the motors. This device was called a "controller".

A streetcar controller consisted of a cast iron and sheet metal cabinet that was mounted vertically on the floor of the vestibule. The controller stood about 3 feet (914 mm) high and was about 17 inches (432 mm) wide. The top consisted of a brass cover which had two square steel shafts protruding a short distance vertically. The right-hand shaft accepted a small metal handle that was called the reverse handle or key. The shaft to which the key was attached rotated a wooden drum inside the controller that metal contacts on it which controlled the direction that the motor armatures rotated. In addition, a gear attached to the shaft unlocked the left-hand shaft if the key was placed in either the "forward" or "reverse" positions. If the key was between these positions, the other controller shaft could not be moved. By means of a notched flange on the cover, the key could only be removed from the shaft if it was between the forward and reverse positions. In this manner, the controller could not be operated unless the key was present. The other shaft accepted a large brass handle that was called the power handle. The power handle rotated a large cast iron shaft inside the controller that engaged various contacts which controlled the voltage that reached the motors. (CGE Drawing of K-6 Controller, December 1909) Such manually operated controllers, which controlled the voltage reaching the electrical circuits of the motors and their direction of rotation, usually had the designation "K". There were many different types of K controllers, each designed for a specific application. On streetcars that had four motors, a K-6 controller could be used. Two motor streetcars could use a K-10 controller. (Cyclopedia of Electricity, Vol. III, 1908, pp. 17-24)

The writing and the functioning of a controller was complicated. Type K controllers were sometimes referred to as "series-parallel" controllers. For part of the time that the controller was on, the motors would be arranged in a series or a series-parallel circuit (depending upon whether the streetcar possessed two or four motors). All motors would be arranged in a parallel circuit when the controller was advanced to the higher voltage positions. The transition from a series or a series-parallel circuit to a parallel circuit provided a wide range of motor speeds. The K-6 controller, the most common type on the ERR which was designed to operate four motors, possessed eleven acceleration steps or notches. As the motorman rotated the power handle clockwise, a gear with eleven teeth would also be moved. This gear engaged a spring-loaded roller which prevented the power handle from resting between notches. Each clockwise movement of the power handle moved copper rings that were mounted on the power shaft into contact with stationary copper "fingers".

These fingers, which were held against the rings by springs, completed circuits between the controller and the motor circuits. The first five notches of the controller were labelled series-parallel since the motors were arranged in a series-parallel circuit in those notches. In addition, large cast iron resistance grids called "rheostats" were placed in series with the motors in four of the five notches. Rheostats, which were held in open steel frames that were insulated from the rest of the streetcar, were mounted underneath the streetcar so that they would be exposed to air for cooling while being protected from water. The rheostats were arranged in three groups according to their resistance values. When the power handle was moved to the first notch, all of the rheostats were placed in series with the motor circuits. The resistance of the rheostats dissipated much of the trolley voltage as heat so the voltage reaching the motors was quite low. As the power handle was moved to higher notches, portions of the rheostats would be shorted out by the controller so higher voltages would reach the motors. When the sixth notch was reached, all the resistance in the circuit was shorted out and the streetcar could run in this position indefinitely. This could not be done with the five previous notches since the heat produced by the rheostats over a long period was sufficient to melt them. At the sixth notch, sometimes called "full series", the streetcar's motors were receiving approximately half power. (Cyclopedia of Applied Electricity, Vol. III, 1908, pp. 17-18, and Doane & Parkham, 1926, § 22 pp. 15-16)

In the seventh notch, referred to as "transition", the controller would place half the resistance back into the circuit while simultaneously changing the connections of the motors from series-parallel to parallel. In the next three steps, the controller would short out portions of the rheostats. In the eleventh notch, each of the motors would be receiving full voltage. In this position, the motors would attain great speed. Figure 35 (after Cyclopedia of Applied Electricity, Vol. III, 1908, p. 18, and Harding & Ewing, 1926, p. 358) shows schematically the eleven steps of operation of a K-6 controller. It should be noted that the operation of a K-10 controller was similar but only two motors were used with it. (CGE Wiring Diagram for K-10 Controller)

In order for the streetcar to back up, the motorman had to place the power handle in the "off" position and place the key in the "reverse" position. The wooden drum inside the controller that was connected to the key engaged copper contacts which changed the polarity of the motor armatures in relation to the polarity of the field coils. Most street railway motors were classified as being "series wound". This meant that the current flowing through the armature would then pass through the field coils. In normal operation, the magnetic field produced by the field coils would cause the armature to rotate in a particular direction. If the polarity of the armature were reversed in relaltion to the field coils, the magnetic field of the coils would cause the armature to rotate in the opposite direction. (Cyclopedia of Applied Electricity, Vol. III, pp. 23-24) This method of reversal was also useful as a safety feature. If for any reason a streetcar lost its braking capability, it was possible for the motorman, while the streetcar was moving, to place the controller's power hande in the "off" position, move the key to "reverse", and reapply power a notch at a time. The action of the magnetic fields within the motors would tend to slow or stop the rotation of the armatures. It should be noted that this maneuver was intended for emergency use only since tremendous stresses were placed on the armatures and the gears. (Harding & Ewing, 1926, p. 158, and ERR Rules and Regulations, 1914, p. 21) Controller reversal should not be confused

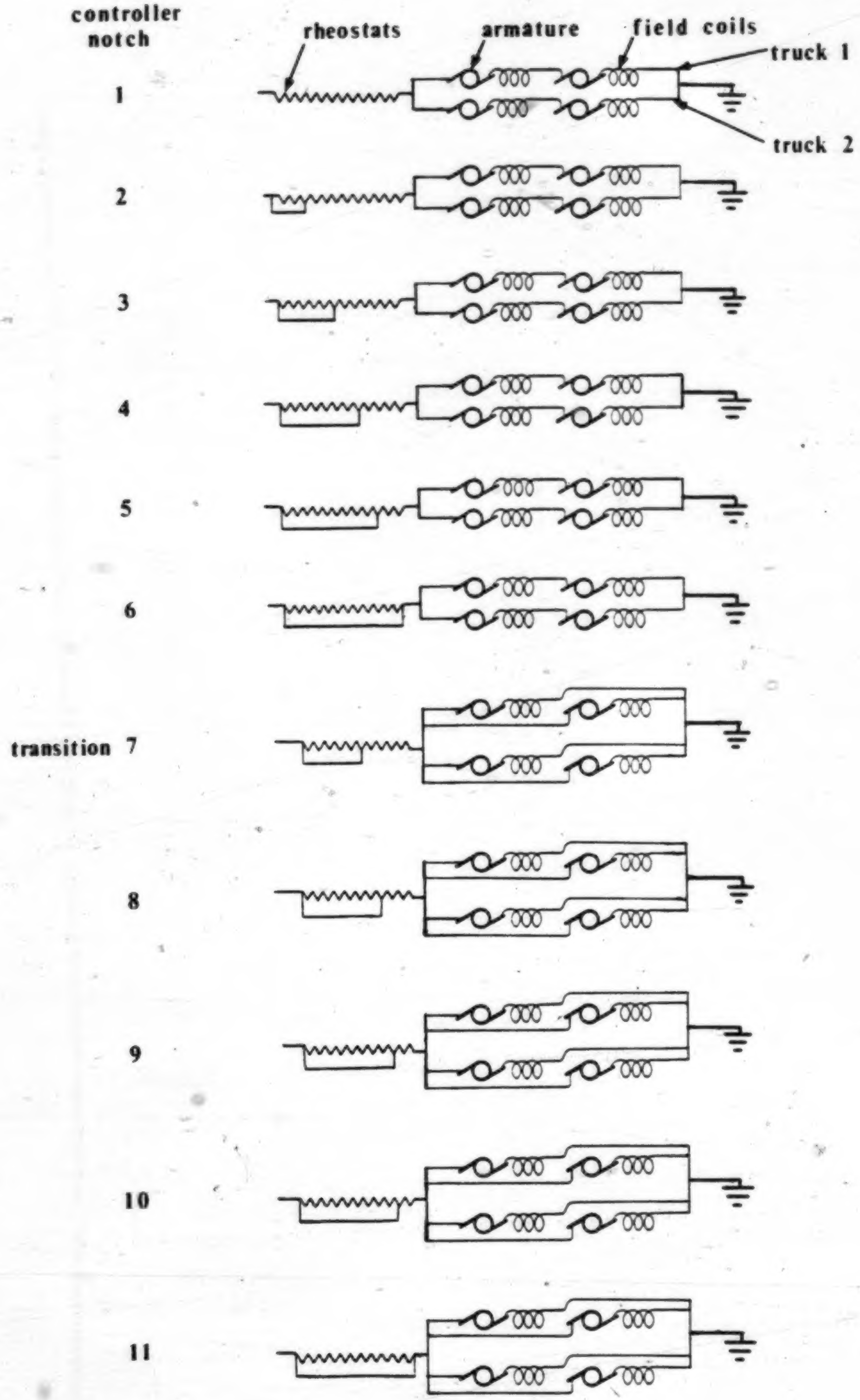

controller notch
rheostats
armature
field coils
truck 1
truck 2
1
2
3
4
5
6
transition 7
8
9
10
11

FIGURE 35. SCHEMATIC OPERATION OF A K–6 CONTROLLER

with the reversing of the direction of travel of a double-end streetcar. When a double-end car reached a terminus, the motorman: set the brakes, opened the circuit breaker at that end, removed both controller handles, lowered the trolley pole then in use, raised the trolley pole at the opposite end (with a short car, a single pole would be swung around from one end of the car to the other), placed the controller handles on the controller at the opposite end of the car to where they had been located previously, and closed the circuit breaker at that end. The streetcar could then proceed.

The K-6 controller contained two knife switches inside the controller cabinet. These switches could isolate the motors on each truck. This feature was extremely useful if one of the two motors on a truck failed. By isolating the affected motor, the streetcar could continue without impeding the other streetcars on that track. (CGE Wiring Diagram for K-6 Controller) Although the K type of controller enabled the speed of the motors to be controlled, the system was inefficient and rough. Each time that the motorman advanced the power handle, the streetcar would lurch because of the sudden change of applied voltage to the motors. In addition, all the time that the rheostats were being used was time that current was being wasted as heat. It was to be many years before a more efficient system of control was developed and used in Edmonton.

When the installation of the electrical equipment was complete, the ERR streetcars were then fitted with lifeguards that were mounted on the front of the vestibules. These lifeguards, called fenders, consisted of a framework of steel tubes that supported a web of leather and canvas straps. If a pedestrian happened to fall directly in front of a moving streetcar, the fender was designed to scoop the pedestrian off the ground, thus preventing the pedestrian from being run over. (Photographs in City of Edmonton Archives) When all of the necessary hardware had been installed, the streetcars were placed in service.

The total weight of each of the six double truck streetcars based upon body weight, truck weight and electrical equipment weight was approximately 40,000 pounds (18 144 kg). Although most of the body construction consisted of wood, these streetcars had a considerable mass. One can, therefore, better understand why such substantial track installations were required to support these streetcars.

Freight and Service Equipment, 1908

It has been mentioned in a previous chapter that the movement of freight was an early concern of the ERR. (See Chapter III) In addition, the winters in Edmonton usually produced copious amounts of snow. In order for the streetcars to be able to operate, a device was necessary that would clear the snow away from the area of the tracks. A vehicle which combined freight hauling capabilities with snow removal would be ideal for the ERR. The McGuire-Cummings Manufacturing Company of Paris and Chicago, Illinois produced a steel-framed combination baggage car and double-end sweeper that met the ERR's requirements. Although many of the passenger streetcars had brushes fitted to the front of their trucks to clear snow away, a heavy snowfall would be too much for the brushes and service could be disrupted. The ERR, therefore, ordered one double end combination baggage and sweeper from McGuire-Cummings before the end of 1908. (CEAR, 1908, p. 81, and McGuire-Cummings Co. Specifications and Drawings of MCB 10-A Truck, October 1908)

The unit consisted of a steel frame approximately 40 feet (12 192 mm) long in which the side, end and intermediate sills were riveted together. (McGuire-Cummings Advertisement in Electric Railway Journal, 1911, reprinted in Traction Heritage, January 1969, pp. 48-49) The sweeper arrangement at each end consisted of a steel support arm bolted to the frame which extended in front of the ends of the unit at a 45° angle for a distance of approximately 5 feet (1 524 mm). A rod attached to the end of the steel support and to the roof of the car prevented the arm from bending at the end. The arm held two vertically slotted castings at the ends and a similar casting in the centre. A narrow steel axle was placed in the slotted castings. The axle had a sprocket attached to it at one end, chains at both ends and several wooden blocks that contained long strips of rattan. The sprocket transmitted power from the broom motor to the axle. The chains, which were attached to winding shafts inside the body, raised and lowered the axle in the slotted castings. The blocks with the rattan strips comprised the sweeper's brooms. On either side of the car, in the centre, a long flat steel blade that was hinged on one end was attached to the bottom of the frame. A chain attached to the free end of the blade enabled the operators to swing the blade out to the side of the unit. The blades were designed to push accumulations of snow away from the track area. (Photographs in the Author's Collection, and Edmonton Journal, April 15, 1909, p. 8)

The body of the baggage/sweeper was of wood construction. Each side contained six small windows that could be opened, as well as a large sliding baggage door in the middle. The ends of the car were semi-circular in shape and contained three windows each. A small swing door was located at two diagonal corners of the body. The baggage doors enabled freight and the broom motors to be replaced and removed, while the smaller doors enabled crews to enter and leave the body. A plain canvas covered arch roof without a monitor was applied to the car.

The unit travelled on two freight trucks that were manufactured by McGuire-Cummings. They carried the designation MCB 10-A. The "MCB" stood for the Master Car Builders which was an association of various railroads and manufacturers that produced design standards for various pieces of rolling stock hardware and equipment. The 10-A truck conformed to the MCB's specifications. Unlike the Brill trucks described previously, the 10-A trucks did not have extensive springing. Hand brakes similar to those described earlier in this chapter were applied to the unit before it was transported to Edmonton. (McGuire-Cummings Co. Specifications for MCB 10-A Truck, October 1908)

Four GE-80A-1 motors (two on each truck) were installed on the unit after it had arrived in Edmonton. Two additional GE-80A motors were installed in the body of the unit. These motors rotated the rattan brooms by means of chains and sprockets. While K-6 controllers were used for the truck motors, smaller controllers were used to regulate the speed of the broom motors. The smaller controllers simply adjusted the amount of resistance in series with the broom motors. (Canadian General Electric Co. Contract for Motors and Equipment, February 1909) A roof mounted incandescent headlight at each end as well as a large brass swing bell were installed on the unit before it entered service. The bell was mounted in the middle of the roof and was similar in size and construction to the bells found on many steam locomotives of that era. During the summer months when the sweeper equipment was not required, the broom arms and the motors were removed from the unit and the car was used for freight purposes. (Edmonton Journal, May 18, 1909, p. 8) Plate 9 (Glenbow Archives) shows the combination baggage car and sweeper on Ross Road, Strathcona during the summer of 1913. The bell on the roof should be noted.

Passenger Equipment, 1909

Before the end of November 1908, it was apparent to the City officials that ridership on the ERR was far in excess of what was predicted. The Superintendent of the ERR, C. E. Taylor, stated in the 1908 Annual Report, "The indications are that the present passenger equipment will have to be doubled in the next few months" (p. 81) On December 1, 1908, the City Council authorized the ERR to call for tenders for four passenger streetcars. (Edmonton Journal, December 2, 1908, p. 1 and p. 3) Although the streetcars were to be similar in basic shape and construction to those already in service, Superintendent Taylor prepared a list of modifications that the new streetcars would have. These modifications were based upon his observations of the streetcars in operation. (Edmonton Journal, November 19, 1908, p. 8) By December 23, a contract for the four streetcars had been made with the Preston Car and Coach Company of Preston (now Cambridge), Ontario. This Company, in addition to the Ottawa Car Company and the St. Louis Car Company (St. Louis, Missouri), submitted bids for the construction of these streetcars. The Preston Car and Coach Company was selected to build the streetcars because it quoted the lowest price of all the bidders. (Edmonton Journal, December 23, 1908, p. 2)

The basic frame, body and vestibule construction was the same as that used for the first seven streetcars. Several modifications were made, however. The vestibules of the first seven streetcars were 4 feet (1 219 mm) in length. Passengers usually remained in the vestibules only to enter the car body or to step off the streetcar. Fare collection on this type of streetcar was accomplished by a conductor who walked the length of the streetcar at frequent intervals with a portable farebox.

Passengers would pay their fares as the conductor passed. Some passengers could avoid paying their fares by either loitering in the vestibules or by leaving the streetcar before the conductor reached them. A fare collection system where a passenger paid the fare before being able to enter the streetcar body was thought to eliminate most free riders. Such a system had been developed in Montreal in 1905 and was called the "Pay As You Enter" or "PAYE" system. (Railway and Marine World, March 1911, p. 246) Streetcars that were equipped with this method of fare collection possessed longer vestibules in order to contain double folding doors. Passengers would enter the streetcar through the left-hand door in the rear vestibule. A system of railings and stanchions inside the vestibule guided the passengers past a conductor and a farebox which was attached to the vestibule floor. After paying the fare, the passenger could then proceed into the streetcar body through a sliding door in the left side of the bulkhead. A swing door on the right side of the bulkhead, which was isolated by stanchions and railings, enabled passengers to leave the streetcar. In addition, passengers could leave the streetcar by a small door in the front vestibule. In order to enable the PAYE system to operate in either direction of travel, double folding doors were so arranged that no matter which direction the streetcar was travelling, the double doors would be located on the right-hand side of the car on the rear vestibule. The right-hand door of the front vestibule was a single-width sliding door. (Railway and Marine World, February 1909, p. 159, and Plate 21) The length of the vestibules on these PAYE cars was 6 feet (1 829 mm). (Edmonton Journal, December 23, 1908, p. 2) In order to facilitate the use of doors at the sides of the bulkheads, the corner seats were aligned longitudinally with the car body. This arrangement gave the streetcar a seating capacity of forty passengers.

(Preston Car & Coach Floor Plan of Streetcars, 1909) The interior finish of these streetcars, unlike the first seven streetcars, consisted entirely of stained birch. (Railway and Marine World, February 1909, p. 159) The use of birch instead of cherry contributed to the comparatively low cost of these streetcars. The interior lighting arrangement of these cars was also improved. Instead of clusters of bulbs along the monitor ceiling, three longitudinal strings of individual bulbs were installed. A string was located directly beneath the monitor sashes along each side of the car while the third string was located along the centre of the monitor ceiling. (Letter to the Ottawa Car Company from the City Commissioners, November 9, 1910, p. 3) The ends of the monitors of the new streetcars did not end abruptly but sloped down from the ends of the car body to the fronts of the vestibules. A monitor of this type was known as having "Bullnose ends" because of the resemblance to the rounded noses of cattle. (Railway and Marine World, February 1909, p. 159) The bullnose ends prevented snow from accumulating on the hoods. On streetcars with straight-end monitors, snow could accumulate on the hoods directly in front of the monitor. A new design of step was also introduced.

A major disadvantage of the single fixed step was that it allowed individuals to attempt boarding the streetcar from either side of the vestibule at any time. If a person were to attempt boarding a streetcar on the wrong side in an area of centre-pole construction, he or she could be struck by one or more of the poles if the streetcar began to move before the person was safely inside the vestibule. At least one accident of this type occurred on the ERR in 1908. Although the individual was not killed in this instance, he was injured severely. (Edmonton Journal, November 7, 1908, p. 1) In an attempt to prevent this type of accident from occurring again, the ERR specified that a sliding step arrangement similar to that used on streetcars in Buffalo, New York be installed. (Plate 21, and Ottawa Car Company Specifications for Streetcars, November 1, 1909, p. 1) The sliding steps were controlled by a lever handle inside the vestibule and were designed so that the step riser would be exposed on one side of the vestibule at a time. The step on the other side of the vestibule would not provide a riser so that passengers could not board or alight from that side of the vestibule. In addition to the sliding steps, the cars were equipped with three small tubes which were mounted along the entire body length of each side near the bottom of the windows. (See Plate 21) These tubes were designed to prevent passengers from sticking their heads or arms out of the windows. Such action could enable the protruding limb to be struck by either a passing vehicle or by an adjacent pole. The tubes were a safety feature that was not installed on the first seven streetcars.

The Preston Car and Coach Company, unlike the Ottawa Car Company, obtained their trucks from the Bemis Car Truck Company of Springfield, Massachusetts. Bemis short wheelbase trucks, type 45, were selected for the four ERR streetcars. While the wheelbase of the Bemis trucks was the same as the Brill 27-GE-1 truck, their appearances were markedly dissimilar. The Bemis trucks had heavier sideframes than the Brill trucks. In addition, the Bemis trucks did not use as many springs as the Brill trucks. (Bemis Car Truck Company Drawing of Number 45 Motor Truck) To assist with the clearing of snow and debris from the track flangeways, each truck was fitted with two steel bristle track brushes. The brushes were placed on the end of the truck that faced the vestibule. (See Plate 21)

The exteriors of the cars were finished in a similar manner to the first seven streetcars except that additional colors were used. The paints were to be supplied by the W. Harland and Son Paint Company. Harland's Coach Painters dark green was applied to the areas of the streetcar below the belt rails while Harland's Birmingham red was applied between the belt rails and the roof. Black was applied to the underframe and the trucks while white was applied to the roofs. (Edmonton Journal, June 29, 1909, p. 8, and Ottawa Car Company Specifications of Streetcars, November 1909, p. 7, and Plate 21) Harland's Coach Painters dark green resembled Pantone ink color 554C while the Birmingham red resembled Pantone ink color 188C. (Color fragments in Author's Collection, and Pantone Matching System Book, 1980) The lettering on the four Preston cars included the City Crest and the car numbers on the sides as well as the numbers on the dashes. The four Preston cars were numbered 10, 12, 14 and 16. This numbering system appears to have been selected as a means of distinguishing Preston built PAYE cars from Ottawa Car Company PAYE cars and from the earlier type of Ottawa car. (Letter to the City Commissioners from ERR Superintendent C. E. Taylor, March 18, 1910) The electrical equipment, supplied by Canadian General Electric, was installed on these streetcars before they were sent to Edmonton. (Railway and Marine World, February 1909, p. 159, and Plate 21) Plate 21 (Public Archives of Canada, PA-137801) shows the appearance of streetcar Number 14 in Preston, Ontario before it was sent to Edmonton in July 1909. The following should be noted: Bemis trucks, track brooms, the three rheostat banks located between the trucks, double-width doors on the rear vestibule, bulkhead doors, lever inside rear vestibule for shifting the rear sliding step, window guards, bullnose monitor ends, and the trolley bases and poles.

Before streetcars 10, 12, 14 and 16 were placed in service, air brakes were installed. When operation began on the interurban line between Edmonton and Strathcona, it was found that the original streetcars which were equipped with hand brakes only had some difficulty slowing quickly or stopping on the steep grades found on that line. The result was irregular service between the two Cities. (Edmonton Journal, December 2, 1908, p. 1 and December 23, 1908, p. 2) The four new streetcars had the air brake equipment installed in Edmonton as soon as they arrived. It should be noted that the air brake equipment could not be installed on the streetcars already in service because removing one or more units from service would have resulted in a reduction of service on the ERR. (Edmonton Journal, April 5, 1909, p. 8)

The air brake equipment was supplied by the Canadian Westinghouse Company of Hamilton, Ontario. (Edmonton Journal, July 27, 1909, p. 3) Straight, double-end equipment was installed. Each streetcar was equipped with: one type D-1-EG electric motor-driven air compressor; one cylindrical steel air reservoir tank; one safety valve for the reservoir set to open above 75 lbs./sq. in. (517 kPa) of air pressure; one electro-pneumatic pump governor set to activate the compressor when reservoir air pressure was below 50 lbs./sq. in. (345 kPa) and set to shut off the compressor when the air pressure rose above 65 lbs./sq. in. (448 kPa); one 10 inch (254 mm) bore by 12 inch (305 mm) stroke, spring return brake cylinder with slack adjuster; two motorman's brake valves, type SX-2 (one located at each end of the streetcar) and one handle; two duplex air gauges, one needle indicating reservoir pressure, the other indicating air pressure to the air brake cylinder, indicated in pounds of air per square inch; two single-pole snap switches with 5 Ampere fuses for air compressor; and two exhaust mufflers. (Canadian Westinghouse Company Air Brake Quotation Sheet, October 19, 1909)

In the basic operation of straight air brakes, the air compressor fills a reservoir with compressed air to a given pressure. When the motorman moved the handle of one of the brake valves to the extreme right, to what was called the "service" position, a path was provided between a pipe from the reservoir and a pipe to the brake cylinder. As long as the motorman held the brake handle in the service position, the air pressure going to the brake cylinder would increase until it matched the reservoir pressure. When the motorman released the brake handle, at any point, the two pipes were sealed from each other and from the atmosphere. This was called the "lap" position. In order to release the air pressure in the brake cylinder, the motorman pulled the brake handle to the extreme left to what was called the "exhaust" position. This action provided a path between the pipe leading to the brake cylinder and a pipe leading to the atmosphere. A heavy coiled spring inside the brake cylinder pushed the piston back causing the air in the cylinder to escape to the atmosphere. In order to reduce the sound caused by the escaping air, a large metal cylinder filled with cotton waste, called a muffler, was attached to the end of the exhaust pipe. (Harding & Ewing, 1926, pp. 383-385, and Westinghouse Part Catalog T3514-1, March 1926)

The most important component of the system was the air compressor. Westinghouse type D-EG compressors were available in several sizes. The size selected depended upon the size of the streetcar and the amount of air pressure required. A D-1-EG compressor, which was the smallest size available, consisted of a 600 volt D.C. motor of approximately 3.5 H.P. (2.6 kW) capacity which was connected to a crankshaft through a set of herringbone reduction gears. Herringbone gears were used because they were quieter in operation than spur gears. The crankshaft was connected, through connecting rods, to two pistons arranged in line, that reciprocated in cylinders that were 5 inch (127 mm) in diameter. Spring-loaded check valves in the cylinder head enabled air from the atmosphere to enter each cylinder during an intake-stroke. During an exhaust-stroke, the air would be exhausted into a pipe which led to the steel air reservoir. After several minutes of operation, the action of the pistons would have produced several pounds per square inch (kPa) of air pressure in the reservoir. A pipe was connected to the reservoir that led to the governor. The air pressure in the pipe acted against a spring which was adjusted to a certain tension. When the air pressure exceeded a set value, the spring would compress, opening a pair of contacts which cut power to the compressor motor. When the reservoir pressure fell below another set value, the spring would decompress and would close the contacts enabling the compressor to provide air pressure. (Westinghouse Instruction Pamphlet T5002, August 1911)

Safety features were incorporated into the air brake system. The air compressor was mounted in a steel cradle which was hung below the frame of the streetcar. To avoid the prospect of electrical hazards, the cradle was insulated from the streetcar's frame by the use of rubber blocks. In addition, the pipes leading from both the compressor and the governor were insulated by rubber union joints. (Allis-Chalmers Company Bulletin 1508, September 1909, p. 6) In order to avoid the possibility of excess air pressure as the result of a governor failure, a spring-loaded safety valve was connected to the reservoir. The valve would open if excessive air pressure was present. The electrical circuit to the compressor was protected by a fuse. In addition, a switch enabled the system to be shut off by the motorman. (Canadian Westinghouse Company Air Brake Quotation Sheet, October 19, 1909)

The air cylinder was bolted to the bottom of the streetcar frame and was attached to the brake levers. It should be noted that hand brakes were still installed on streetcars that were equipped with air brakes. The movement of the brake piston moved the brake levers and caused the brake shoes to be applied. The purpose of the slack adjuster mentioned earlier was to compensate for brake shoe wear. As the brake shoes wore down, the brake piston had to travel further in order to provide adequate braking force. This meant that it took longer for the brakes to be applied. A slack adjuster usually prevented this from occurring. The slack adjuster consisted of a threaded shaft which was connected to a brake lever by means of a clevis. Two steel guides, called a crosshead, were attached to the end of the brake cylinder. The opposite end of the crosshead held a steel nut which was attached to the threaded shaft and which was also attached to a ratchet gear. A housing surrounding the ratchet gear, which was attached to the end of the crosshead, contained a small air cylinder which contained a spring-loaded piston which had a pawl attached to one end. A pipe led from the air cylinder to a connection in the side of the brake cylinder. If the travel distance of the brake piston became too great, a hole in the side of the brake cylinder would become uncovered. The compressed air inside the brake cylinder would then travel through the pipe to the slack adjuster cylinder. This action caused the slack adjuster piston to descend, thus engaging the pawl on the ratchet gear. When the brakes were released, the air to the slack adjuster would be cut off and the spring in its cylinder would pull the piston back up, causing the steel nut to be rotated by the action of the pawl against the ratchet gear. The movement of the nut caused the brake lever to move, which also moved the brake shoes closer to the wheels of the streetcar. In this manner, the slack adjuster prevented the brake application time from increasing. It should be noted that when the brake lever reached the end of the crosshead, it was time for the brake shoes to be replaced. (Westinghouse Company Publication SA-2, January 1924) Figure 36 (after Westinghouse Publication SA-2, January 1924, p. 4) shows the plan and side views of a slack adjuster and brake cylinder and lever arrangement for a 10 inch by 12 inch (254 mm by 305 mm) Westinghouse brake cylinder.

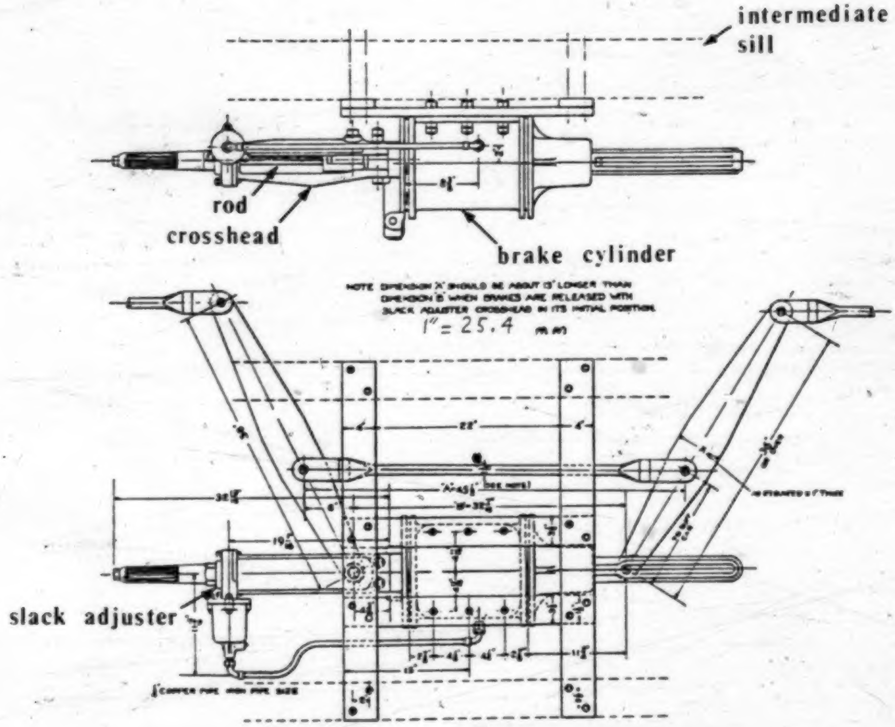

intermediate sill
rod
crosshead
brake cylinder
NOTE DIMENSION "X" SHOULD BE ABOUT 13" LONGER THAN DIMENSION "B" WHEN BRAKES ARE RELEASED WITH SLACK ADJUSTER CROSSHEAD IN ITS INITIAL POSITION
1" = 25.4 mm
22"
4"
slack adjuster

FIGURE 36. SIDE & PLAN VIEWS OF A WESTINGHOUSE FORM "J" SLACK ADJUSTER

Freight and Service Equipment, 1909

During the early part of the twentieth century, most private vehicles in Edmonton were horse-drawn carriages and wagons. The horses pulling these vehicles would defecate frequently on the streets on which they travelled. In the summer months especially, it was necessary to remove this filth quickly in order to keep odours and the risk of disease to a minimum. In the past, horse-drawn sprinkler wagons were used along paved streets in an attempt to flush the horse manure to the sides of the street where it could be more easily removed by sanitation crews. These horse-drawn sprinkler wagons had a small capacity and lacked enough pressure to be effective because they had no means to pump the water. Many street railway car builders produced large, self-powered sprinklers which were mounted on frames and which could travel along street railway tracks. Besides having a large capacity, the street railway sprinklers were usually equipped with electrically powered pumps which pressurized the water inside the tank so that it was expelled with great force. By May 1909, the City Commissioners had decided that a street railway sprinkler was required to supplement the two horse-drawn sprinklers already in service. (CECR No. 52, May 4, 1909) Two bids were received, one from the McGuire-Cummings Manufacturing Company, and the other from the Preston Car and Coach Company. The bid of the Preston Car and Coach Company was almost half the cost of the McGuire-Cummings unit. This price differential was the result of high import duties for American goods. (CECR No. 52) The sprinkler was ordered, therefore, from the Preston Car and Coach Company. It was intended that the sprinkler would primarily operate along paved streets but it was also intended to operate the sprinkler along some dirt streets in an attempt to keep dust to a minimum since such dust tended to make the passenger streetcars extremely dirty. (CECR No. 52)

The sprinkler unit consisted of a riveted steel frame which was composed of 12 inch (305 mm) wide steel channel. Wood was placed within the channel and bolted to it in order for a wooden deck to be attached to the frame. The frame, which was strengthened by two supplemental truss rods, was placed on two Bemis 45 trucks. (Preston Car & Coach Co. Specifications of Street Sprinkler, April 1909, pp. 1-2) A 2 inch (51 mm) thick wooden deck was laid crosswise on top of the frame. Shaped oak blocks were then bolted to the deck. These blocks were designed to hold the steel tank in place. The tank, which held approximately 5,000 imperial gallons (22 730 L) was 74 inches (1 880 mm) in diameter by 20 feet (6 096 mm) in length. The tank was fabricated of riveted steel plates and was secured to the oak blocks by strips of band iron wrapped around three-quarters of the circumference of the tank to form a "U". The tank was usually filled by means of a canvas hose. A small compressor was mounted on the underside of the sprinkler's frame. Through pipes connected to the tank, the compressor was designed to provide 80 lbs./sq. in. (552 kPa) of pressure within the tank. Three inch (76 mm) diameter pipes equipped with sprinkler heads were placed at each corner of the car. Each sprinkler head could be controlled by a valve. Each end of the sprinkler car had a 34 inch (864 mm) high steel dash which protected the controller, brake staff and the motorman. A gong was also mounted on each dash. A tubular framework located above the dash held a quantity of striped canvas duck which could be drawn across the framework and secured in order to protect the crews from rain. Hand brakes only were supplied with the sprinkler. (Preston Car & Coach Co. Specifications of Street Sprinkler, April 1909, pp. 1-2)

Although the sprinkler was painted and lettered "Edmonton Radial Ry.", the precise color was not specified. It appears likely that the sprinkler was originally painted Harland's Coach Painters dark green since hand-tinted post cards of that period depict the sprinkler as being a dark green. (Post Card in Glenbow Archives, and a similar post card in the Author's Collection)

The City Commissioners hoped that the sprinkler would arrive in Edmonton during the summer but it did not arrive until September 1909, at which time the motors and electrical gear were installed. (Edmonton Journal, September 20, 1909, p. 1) It should be noted that only two GE-80A-1 motors were originally installed on the sprinkler, both motors being connected to one truck. (Plate 22, and Appendix I) Plate 22 (Provincial Archives of Alberta) depicts the Preston sprinkler in Edmonton during the summer of 1910 or 1911.

Equipment Modifications, 1909

It was mentioned in a previous section that steel track brushes were supplied with streetcars 10, 12, 14 and 16. After some use, it was found that these brushes were not successful in removing ice from the track flangeways. In an attempt to improve the cleaning of the flangeways, the ERR manufactured spring steel scrapers which were attached to the trucks on each streetcar and which replaced the track brooms. (SRDGL, Account I, October 30, 1909) These locally-made scrapers do not appear to have been too successful or appear to have been used for many years since there are few references to them in subsequent years.

The accumulation of frost on the vestibule windows was another problem that bedevilled the ERR during its early years of operation.

Plate 22. (Provincial Archives of Alberta) Preston Sprinkler

Plate 23. (Glenbow Archives) Streetcar Number 18
On Namao Avenue

STRATHCONA

Although the vestibule sashes could drop into sash pockets, this was not usually done during winter since it was extremely uncomfortable for the motorman to face the winter winds. One ERR motorman developed a solution of glycerine and alcohol which could be applied to the inside of the windows to prevent the formation of frost. This solution was used for a brief time. (SRDGL, Account 20, March 30, 1909) It was found that by double glazing the vestibule windows the formation of frost would be kept to a minimum without the use of a protective solution. All passenger streetcars on the ERR were eventually fitted with double-glazed vestibule windows. (Letter to the City Commissioners from ERR Superintendent C. E. Taylor, December 28, 1909)

During the winter of 1908-1909, it was found that the crews operating the sweeper suffered from the cold since that unit was not equipped with heaters. Electric heaters were not installed in the sweeper because there was a power shortage on the ERR at that time. In order to provide some comfort to the sweeper crews, a small wood and coal burning stove was installed in the sweeper during 1909. (SRDGL, Account 16, November 30, 1909) The stove was located near the centre of the body and a stove pipe was placed through the roof in order to allow the smoke and exhaust gases to escape. (Provincial Archives of Alberta Photograph A-1387)

Passenger Equipment, 1910

The extensions of trackage and the increase in ridership on the ERR in 1909 prompted the ERR management to ask the City Council for authorization to purchase additional passenger streetcars. On October 13, 1909, the City Council authorized the ERR to purchase six streetcars from the Ottawa Car Company since that firm was the low bidder.

(Edmonton Journal, October 14, 1909, p. 10) The six Ottawa cars were to be of similar size and construction to the four Preston cars. There were some modifications, however. The interior seating was reduced to thirty-two so that passengers could more easily enter and leave the car body. The interior seating consisted of twelve reversible cross-seats and four longitudinal seats, one of which was placed near each corner of the car body. (Ottawa Car Co. Specifications of Streetcars, November 1909, p. 1, p. 5)

The interior signal system was changed. Instead of a suspended rope running the entire length of the car body that was attached to hammer gongs in each vestibule, these streetcars were equipped with a low voltage electric bell located in each vestibule. Push buttons were located in the side posts near each seat in the car body. (Ottawa Car Co. Specifications of Streetcars, November 1909, p. 6) The bell system used several dry cell batteries connected in series to provide the necessary power to ring the bells. The push buttons were wired in parallel so that if any one were pushed, it would ring the bells. (Electric Service Supplies Co. Catalog No. 7, 1923, pp. 211-213) Unlike the four Preston streetcars, the new order of Ottawa streetcars reverted to the central cluster lighting that was used on cars 1 through 7. (Letter to the Ottawa Car Co. from the City Commissioners, November 9, 1910, p. 3) In addition, the interior of the Ottawa car bodies were finished with cherry instead of stained birch. (Ottawa Car Co. Specifications of Streetcars, November 1909, p. 4) The vestibule sashes were double glazed as well so that frost would not readily form on them. (Letter to the City Commissioners from ERR Superintendent C. E. Taylor, December 28, 1909)

The dashes of these streetcars were sheathed with vertical wood siding instead of sheet steel. There was, however, a small galvanized sheet metal strip that was placed over a tapered piece of wood which sloped down from near the bottom of the dash to the top of the bunter. (Ottawa Car Co. Specifications of Streetcars, November 1909, pp. 2-3)

Although the cars were equipped with Brill 27-GE-1 trucks, cast iron wheels were not used. Solid rolled steel wheels, 34 inches (864 mm) in diameter, were used instead. (CECR No. 143, December 28, 1909, and Letter to the Ottawa Car Co. from the City Commissioners, November 9, 1910, p. 3) The ERR had found that the cast iron wheels were quickly worn down. It was believed that the extra cost of the rolled steel wheels would be offset by their much longer life than the cast iron wheels. (CECR No. 143, December 28, 1909)

The exteriors of the cars were finished in a similar manner to the four Preston built cars except that the roofs of the new Ottawa built cars were painted black. (See Plate 23) The numbering of the Ottawa cars was 15, 17, 18, 19, 20 and 21. (Ottawa Car Co. Specifications of Streetcars, November 1909, p. 7, and SRDGL, Account C6A) Although these streetcars were equipped with hand brakes, they were not mounted on trucks when they were sent to Edmonton. As a cost saving measure, the ERR purchased the motor and air brake equipment separately, as they had done with streetcars 1 through 7. To further reduce labor costs and to enable the trucks to be ready for installation, they were sent to Edmonton before the streetcar bodies were sent. (SRDGL, Account E-2, May 31, 1910)

The electrical equipment for these streetcars was purchased from the Canadian General Electric Company, while the air brake equipment was purchased from the Canadian Westinghouse Company. These manufacturers were selected because their products had been used by the ERR previously and had been found satisfactory since no major defects had been encountered. (CECR No. 129, November 22, 1909) While most of the electrical equipment was the same as that supplied for earlier ERR streetcars, new heavier trolley bases were supplied. (Canadian General Electric Co. Contract for Electrical Equipment, December 6, 1909) These trolley bases, designated U.S. (for "union standard") 13, contained four springs instead of two, which pulled the trolley pole up. In addition, the spring base rested on a roller bearing which was also secured to the fixed base. The use of a roller bearing enabled the spring base to swivel smoothly and easily, thus preventing some dewirements. (General Electric Co. Bulletin 4642A, April 1909)

Before these streetcars were placed in service, fenders were installed by ERR crews. (SRDGL, Account E-2, May 16, 1910) Instead of the framework type of fender used previously, these streetcars were equipped with lifeguards at both ends, manufactured by the Hudson Bowring (HB) Company. (See Plate 23) The HB lifeguards were permanently attached to the underside of the vestibules and consisted of a wood and steel cradle which could be lowered at one end by pushing a wood and steel "gate" which was suspended from the front of the vestibule. If a pedestrian happened to fall in front of a moving streetcar equipped with such a fender, the gate, which was hinged so that it swung, would strike the pedestrian and would be deflected back towards the car body. This action would cause rods and springs attached to the gate and cradle to lower the free end of the cradle onto the rails. The cradle would contain the pedestrian, preventing the individual from being crushed by the trucks. A foot plunger located in the vestibule enabled the motorman to reset the lifeguard. (Hudson Bowring Drawing of Patent Lifeguard, 1908, and ERR Drawings of HB Lifeguard, 1912) Plate 23 (Glenbow Archives) shows the appearance of streetcar Number 18 in late 1910. The HB lifeguards, solid steel wheels, wooden sheathing on the dash and the sliding steps and door should all be noted.

Before streetcars 15, 17, 18, 19, 20 and 21 arrived in Edmonton, ERR Superintendent C. E. Taylor wrote to the City Commissioners requestin them to order additional rolling stock at once in order for the ERR to provide adequate service on the new track extensions being constructed. (March 8, 1910) Three bids were received for new streetcars by March 29. Bids were received from: Ottawa Car Company, Preston Car and Coach Company, and the Silliker Car Company. The lowest bid was submitted by the Ottawa Car Company. The City Commissioners recommended that the streetcars be purchased from the Ottawa Car Company. (CECR No. 44, March 29, 1910) A contract was made with the Ottawa Car Company to supply six streetcars which were to be built to the same specifications as the previous order for six streetcars. (CECR No. 139, August 29, 1910) It was hoped that these streetcars would arrive in Edmonton by August 1910 when they would be required for service.

By the beginning of July 1910, the ERR learned that the Ottawa Car Company had not yet begun the construction of the streetcars. The ERR management, the City Commissioners and the City Council had all agreed that single ended streetcars should be tried, since such streetcars required half the number of controllers and air brake valves that double end streetcars needed. Besides reducing the capital cost of such equipment, the maintenance costs would also be reduced because there would be fewer items to be maintained. (CECR No. 139, August 29, 1910) The order for the six double end streetcars was cancelled. A new order for six single end streetcars was negotiated with the Ottawa Car Company. The ERR, nevertheless, was six passenger streetcars short by the end of 1910.

Freight and Service Equipment, 1910

The extensive track extensions of 1909 and 1910 caused the ERR management to believe that a second sweeper was required if all of its lines were to be cleared of snow quickly. In August 1910, the ERR placed an order with the Ottawa Car Company for one double end sweeper which was to be delivered no later than November 1. (Letter to the Ottawa Car Co. from the City Commissioners, August 26, 1910)

This sweeper was much shorter than the McGuire-Cummings unit. (See Appendix I) The new sweeper possessed a wooden frame and was placed upon two pedestal trucks. Pedestal trucks consisted of large steel castings that were bolted to the side sills. A slot in the bottom of each pedestal held a spring and a journal box. Steel bars were bolted between the pedestals to keep them the correct distance apart. Steel rods were also placed between the pedestals and the ends of the sweeper as extra support for the frame. Unlike the McGuire-Cummings unit, the broom assemblies on the Ottawa Car Company sweeper did not project far in front of the body. By placing the broom assemblies beneath the frame, it was possible for both broom assemblies to be driven by a single motor inside the sweeper body. (Ottawa Car Manufacturing Co. Catalog, pp. 10-11, and Plate 24) The electrical equipment for the sweeper was ordered from the Canadian Westinghouse Company because they provided the lowest bid for that equipment. (Canadian Westinghouse Co. Contract for Electrical Equipment, October 1910) The ERR had wished to place the sweeper in service immediately upon its arrival in Edmonton so the electrical equipment was sent to the Ottawa Car Company factory where it was installed on the sweeper by Ottawa Car workers. (SRDGL, Account C6B, December 9, 1910) The sweeper used three Westinghouse 101-B motors. Two of the motors were connected to the axles, one per axle, through spur gears with a ratio of 15 to 69. These motors, which carried the designation 101-B-2, were controlled by K-10 controllers, one installed in each end of the sweeper body. The broom motor was also a WH-101-B but it was controlled by a single R-28 (straight resistance) controller. (Canadian Westinghouse Co. Contract for Electrical Equipment, October 1910, and Westinghouse Specifications of 101-B Motor) A clutch mechanism connected to the broom motor's drive axle prevented both sets of brooms from rotating at the same time. (Ottawa Car Manufacturing Co. Catalog, pp. 10-11)

The ERR specified that the sweeper was to come equipped with 14 inch (356 mm) diameter foot gongs installed at each end. The rationale for requesting such large gongs was, "such a car requires large gongs on account of the noises made by it in operation" (Letter to the Ottawa Car Co. from the City Commissioners, August 26, 1910, p. 1). The sweeper which was designated Number 2 arrived in Edmonton in early December. (SRDGL, Account C6B, December 9, 1910) It is not known what color this sweeper was painted originally or what type of heating apparatus it was provided with initially. Plate 24 (Ernie Plant, Public Archives of Canada) shows the second sweeper at the Cromdale streetcar barns in 1946. It should be noted that the sweeper was numbered 3 at this time. The pedestal trucks should also be noted.

Equipment Modifications, 1910

The successful operation of the air brakes on streetcars 10, 12, 14 and 16 encouraged the ERR to install air brakes on the first double truck passenger streetcars purchased. It should be remembered that streetcar Number 7, the single truck vehicle, could not be fitted with air brakes since there was insufficient room beneath it for the compressor

Plate 24. (Public Archives of Canada) Original Sweeper Number 2, Renumbered 3

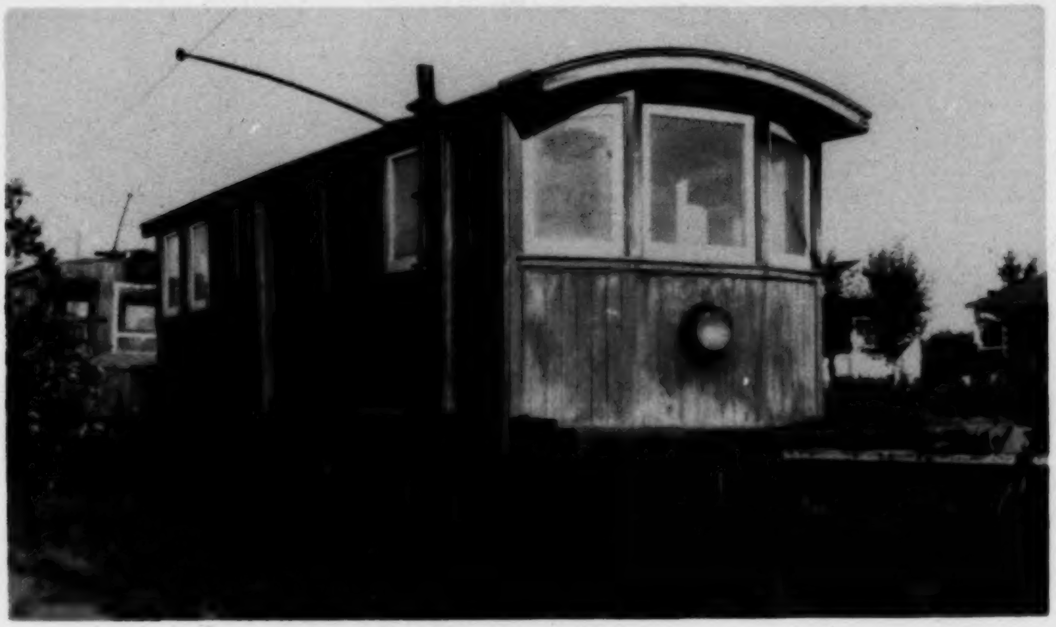


Plate 25. (Author's Collection) Streetcar Number 29

MARVEL
MARVEL

and the reservoir tank. The Canadian Westinghouse Company was chosen to supply nine sets of double end straight air brake equipment by the end of April. It is not known why nine sets were ordered since streetcars 1 through 6 were the only passenger cars to require air brakes. The extra equipment does not seem to have been installed on the freight and service equipment. An accident report of January 1915 indicated that the combination sweeper/baggage car possessed hand brakes only. (Street Railway Department Accident Report 2325, January 19, 1915) The air brake equipment that was ordered was practically identical to the equipment that had been ordered for other ERR streetcars. The brake cylinders supplied with this order were smaller. Instead of being 10 inches (254 mm) in diameter, their diameter was only 8 inches (203 mm). The smaller cylinder size appears to have been selected because streetcars 1 through 6 were smaller than subsequent double track passenger streetcars and, therefore, did not require as much braking power. (Canadian Westinghouse Co. Contract for Air Brake Equipment, March 23, 1910) The ERR received an added inducement to install air brake equipment on their passenger streetcars when the BRC issued General Order 56 in May 1910. The Order stated that,

> On or before June 1, 1911, all electric Railway Companies under the jurisdiction of the Board, shall equip all rolling stock in use by them of thirty-seven (37) feet [11 278 mm] or over in length, or of the weight 35,000 pounds [15 876 kg] or more, with power brakes, to be approved of by the Board, in addition to hand brakes and proper sanding appliances.

From this point onwards, all passenger equipment which fell under General Order 56 would be equipped with air brakes.

Seven sets of tubular body window guards were ordered from the Ottawa Car Company in 1910. (SRDGL, Account E-1) These guards were similar in appearance to the window guards applied to the four Preston built streetcars and were installed on streetcars 1 through 7 in order to prevent passengers from sticking their heads and arms out of the windows.

Several of the older streetcars were fitted with HB lifeguards during 1910. HB lifeguards were fitted onto all streetcars by the end of 1912. (SRDGL, Account 5B) It should be remembered, from the previous section on passenger equipment, that the HB lifeguard was considered to be superior to the framework type of fender then in use. In addition to the lifeguards, rolled steel wheels were installed on several of these streetcars since the original cast iron wheels had worn out. The ERR did not have the facilities or the equipment necessary to remove or replace wheels on the axles so the services and the equipment of the Canadian Northern Railway were obtained for these tasks. (SRDGL, Account 5B)

A different type of headlight was tried during this period. In the past, streetcars were equipped with a single incandescent headlight at each end. The light produced by this type of headlight was usually weak. In addition, as the motorman increased power to the motors, the light dimmed. In an attempt to eliminate this problem, the ERR purchased a number of arc headlights from the Union Standard Headlight Company. (SRDGL, Account E2) These headlights were similar in external appearance to the incandescent headlights. Instead of containing an incandescent bulb, the arc headlights contained two carbon electrodes which were enclosed in a large glass globe. The tips of the electrodes were spaced a short distance apart. When trolley voltage was applied to the lamp, an arc was formed between the electrodes, resulting in a bright white light. A solenoid attached to one of the electrodes served to move that electrode closer to the fixed electrode as they wore away. In addition, when power to the arc diminished, the solenoid would move the electrode closer, thus maintaining the intensity of the arc at a constant level. (Doane & Parkham, 1926, § 22 pp. 24-27)

Although the operation of the arc headlights was superior to the incandescent headlights, the arc headlights required more power than the incandescent headlights. Arc headlights were not used, therefore, until the power shortage problems on the ERR had been eliminated. (SRDGL, Account E2)

The ERR also purchased a number of trolley catchers for use on several passenger streetcars. (SRDGL, Account E2) A trolley catcher was a cylindrical device which contained a coiled spring, a drum with several pawls on its exterior, and ratchet teeth on the inside of the housing. The purpose of a trolley catcher was to prevent the trolley pole from bouncing and flailing about should the trolley wheel dewire. In this way, damage to both the trolley pole and the overhead could be kept to a minimum. In the past, the conductor was supposed to hold the trolley rope when the streetcar travelled through curves or special work. In many instances, the conductor was otherwise preoccupied so if a dewirement did occur, damage to the overhead could result. (ERR Inspector's Report, April 13, 1911) In normal operation, the trolley catcher was mounted onto a socket which was attached to one side of the dash. The trolley rope was wrapped around the drum inside the catcher. The coiled spring pulled on the drum and the trolley rope so that it was always taut. If the trolley wire left the wire, the sudden movement of the rope would cause the drum to rotate rapidly. This rapid rotation caused the pawls on the drum to swing out and to engage the ratchet teeth which were located on the inside of the housing, thus preventing any further upward movement of the trolley pole. (Doane & Parkham, § 22 pp. 7-8) The trolley catchers were not successful since the pawls frequently broke. This occurred because the catchers were designed to be operated with trolley bases which were set to no more than 25 pounds (11 kg) of tension. The ERR trolley bases, however, were set to exert a tension between 30 and 40 pounds (13.6 to 18 kg). (CECR No. 211, October 1, 1915)

Passenger Equipment, 1911

It was mentioned in the previous section on passenger equipment that an order for six double end streetcars (that had been placed with the Ottawa Car Company during April 1910 and which was long overdue) was cancelled and renegotiated with that Company during October. The main reason for the change from double end to single end was because the City administrators believed that there would be a considerable saving in the cost of electrical and air brake equipment and their maintenance if single end cars were adopted. In addition, it was believed that the savings would be so great that they would offset the construction costs of Y's and loops which were required for turning single end cars at the termini of routes. (CECR No. 139, August 29, 1910)

The construction of the six single end streetcars was similar to the construction of the earlier single end streetcars that were in use. There were several differences, however. Only one vestibule (the rear) was to be used for boarding so it was not necessary to have such a long front vestibule. The front vestibules were 5 feet (1 524 mm) in length while the rear vestibules were 7 feet (2 134 mm) in length. (Ottawa Car Co. Specifications of Streetcars, October 20, 1910, p. 1) A single sliding door was placed in the centre of the front bulkhead since the front vestibule was to be used only by passengers wishing to disembark. The use of two doors in the rear bulkhead was continued since passengers could board as well as leave the streetcar through the rear vestibule. The interior seating was also modified. Fixed cross seats were used instead of the reversible type used previously. Longitudinal seating was not used in these streetcars. (Ottawa Car Co. Specifications of Streetcars, October 1910, p. 6) In order to enable passengers to pass through the rear bulkhead easily, one row of cross seats was omitted. A small single cross seat was installed against the rear bulkhead next to the sliding door. (Ottawa Car Co. Drawing F355) The interior lighting of these streetcars was similar to the lighting arrangement used on streetcars 10, 12, 14 and 16 except that the new streetcars had a lamp placed in each vestibule. (Letter to the Ottawa Car Co. from the City Commissioners, November 9, 1910, p. 3)

Single tread fixed steps were installed on these streetcars instead of sliding steps since there were doors only on one side of these streetcars. (Ottawa Car Co. Specifications of Streetcars, October 1910, p. 3) The streetcars were finished and painted in a similar fashion to the last streetcars received except that these streetcars were numbered 8, 9, 11, 13, 22 and 23. (Ottawa Car Co. Specifications, p. 7) Two Brill 27-GE-1 trucks with 34 inch (864 mm) diameter rolled steel wheels were attached to each streetcar. The motor and air brake equipment, supplied by the Canadian Westinghouse Company, were installed by the Ottawa Car Company. This was done in order that the streetcars would be ready for immediate service upon their arrival in Edmonton. (Letter to the Ottawa Car Co. from the City Commissioners, November 9, 1910, p. 1) It should be noted that the keys and the keyways for the axle gears were standardized with this order so that either General Electric or Westinghouse motors could be used. This interchangeability facilitated motor maintenance and gear replacement. (Letter to the Ottawa Car

Co. from the City Commissioners, November 9, 1910, p. 3)

The Ottawa Car Company promised delivery of the six streetcars by April 1911, which would have been one year since the initial order for six double end streetcars had been placed. The City Commissioners remained skeptical, "judging from our past experience with the Ottawa Car Company it is doubtful if the cars will be delivered before the time promised or even then" (CECR No. 191, November 22, 1910). The first four streetcars were delivered in April, while the remaining two were delivered in June. (SRDGL, Account C6E) Track and service extensions on the ERR continued, however, and it was deemed imperative that eight additional streetcars be ordered for 1911 delivery. In addition to increasing service, the additional streetcars were required to enable those already in use to be removed from service for repairs and modifications. (CECR No. 191, November 22, 1910)

The order for eight streetcars was split between the Ottawa Car Company and the Preston Car and Coach Company. This action was taken to ensure that at least four of the streetcars would be in Edmonton in time for the summer exhibition and fair period. As far as the ERR and the City Commissioners were concerned, the Ottawa Car Company's record for delivery on time was poor and although that company had submitted the lowest bid, it was doubtful that the streetcars would be delivered by the time promised. (Letter to the Ottawa Car Co. from the City Commissioners, December 7, 1910, p. 3) The remaining four streetcars were ordered from the Preston Car and Coach Company solely because that company had delivered their products to Edmonton quickly. In a letter to the Preston Car and Coach Company, the City Commissioners stated, "the order is placed with you at a price considerably higher than quoted by other builders of the same type of car, and on award of the contract to you at such a higher price is based upon our confidence in your ability to make delivery within the time period" (December 7, 1910, pp. 3-4) The contract with the Ottawa Car Company was finalized by the end of December while the contract with the Preston Car and Coach was finalized in February 1911. (Ottawa Car Co. Contract, December 30, 1910, and Preston Car & Coach Co. Contract, February 6, 1911)

The basic construction of the eight streetcars was the same as the construction of the previous twenty-three streetcars. The length of the bodies, however, was extended to 30 feet 6 inches (9 296 mm). (Ottawa Car Co. Specifications of Streetcars, December 1910) This addition of 2 feet 6 inches (762 mm) enabled each body to have an additional side window, making a total of eleven body windows on each side. Two additional cross seats could be installed in each of the streetcars, thus increasing their seating capacity. (Letter to the Preston Car & Coach Co. from the City Commissioners, December 7, 1910, pp. 1-2; see also Appendix I) An additional window was also placed in each side of the monitor. The appearance of the windows differed between manufacturers. The sashes installed by the Ottawa Car Company were rectangular with slightly rounded corners at the top. (See Plate 23) Preston Car and Coach, however, designed their sashes so that the tops curved. With the exception of the centre body window which had square corners, the tops of the body windows were curved so that each formed a half of a semi ellipse. The tops of two adjacent windows would, therefore, form a semi ellipse. (See Plate 25) With the exception of the centre window which was rectangular, the top of each monitor window was curved to match the corresponding body window below. Curved window tops served no structural purpose but were used for esthetic reasons. It is most likely that these Preston built streetcars had curved window tops because they were constructed along with an order for several Calgary streetcars, which were usually constructed with curved window tops. (Letter to the Preston Car & Coach Co. from the City Commissioners, December 7, 1910, and Photographs of Calgary Streetcars in the Glenbow Archives) It is likely that the Preston Car and Coach Company fabricated only one type of sash in order to keep production costs to a minimum.

The ERR had found the Bemis trucks to be rough riding and difficult to maintain since they required different parts than the Brill 27-GE-1 trucks. In order to maintain some semblance of truck standardization, eight pairs of Brill 27-GE-1 trucks were ordered through the Ottawa Car Company with instructions that four pairs were to be sent to the Preston Car & Coach Company. The electrical and air brake equipment was supplied by the Canadian Westinghouse Company and was installed by the streetcar builders before the units were sent to Edmonton. (Letter to the Preston Car & Coach Co. from the City Commissioners, January 24, 1911, pp. 1-3)

Instead of track brushes, commercially manufactured spring steel scrapers were installed at the front of each truck. These scrapers were manufactured by the Root Spring Scraper Company of Kalamazoo, Michigan. (Letter to the Preston Car & Coach Co. from the City Commissioners, January 24, 1911, p. 3, and Electric Railway Journal, August 20, 1910, p. 316) Gravity operated sanders were not supplied with these streetcars. Instead, air operated (pneumatic) sanders were installed. The placement of the sanders in these streetcars differed from their placement in double end streetcars. In single end streetcars, both sanders were located at the front of the streetcar, each being located over one of the rails. (Letter to the Preston Car & Coach Co. from the City Commissioners, January 24, 1911, p. 3) A pneumatic sander consisted of an iron casting which was shaped so that sand would collect at the bottom. Sand could leave the casting through a curved section which prevented the sand from falling out by gravity. A small pipe, which was attached to the air brake pipe leading from the main reservoir, was installed in the front vestibule between the controller and the brake valve. A small valve was then connected to the end of the pipe. Through means of a small handle which was connected to a spring-loaded valve seat, the air flow could continue through the valve when the handle was depressed. Another pipe leading from the valve was connected to the side of the casting near its base. When the valve handle was depressed, the resulting blast of air in the sander casting forced a quantity of sand onto the rails. (Electric Service Supplies Co. Catalog No. 7, 1923, pp. 457-462, and Cyclopedia of Applied Electricity, Vol. III, 1908, pp. 64-65) The major advantage of a pneumatic sander over a gravity sander was that a vast array of levers, which were prone to freezing in winter, was not required.

Electric heaters were not installed on these streetcars. The electric heaters that were then in use required copious amounts of electricity in order to heat the interiors of the streetcars effectively. The ERR, during this period, was in the midst of a power shortage and the use of electric heaters intensified the power shortage problem. In addition, the vestibules were rarely warm enough for the motorman or the conductor, although large electric heaters had been installed there. (Letter to the Ottawa Car Co. from the City Commissioners, January 25, 1911, p. 4; Letter to the Preston Car and Coach Co. from the City Commissioners, January 25, 1911, p. 4; and CECR No. 211, October 1, 1915) It was the intention of the ERR to install coal-fired forced air heaters in each streetcar before winter weather arrived, thus eliminating the need for electric heaters. (Letter to the Preston Car & Coach Co. from the City Commissioners, January 24, 1911, p. 4) The forced air heaters will be described in a subsequent section.

The eight streetcars were painted in a similar fashion to the latest streetcars received. The words "entrance" and "exit" were also painted on the step risers below the appropriate doors. (Letter to the Preston Car & Coach Co. from the City Commissioners, January 24, 1911, p. 6) The four streetcars from the Ottawa Car Company were numbered 24 through 27, while the four Preston built streetcars were numbered 28 through 31. (Letter to the Ottawa Car Co. from the City Commissioners, January 20, 1911, p. 2, and Letter to the Preston Car & Coach Co. from the City Commissioners, January 4, 1911, p. 5)

Streetcars 28 and 29 arrived in Edmonton on June 16 and streetcars 30 and 31 arrived on July 4. (SRDGL, Account C6D) Streetcars 24 through 27 arrived between August 15 and September 8. (SRDGL, Account C6E) The City Commissioners' earlier prediction that the Ottawa Car Company would deliver its streetcars late was proven to be correct. The continual tardiness of the Ottawa Car Company was to ensure that further orders for streetcars placed by the ERR would go to competing builders. Plate 25 (Author's Collection) shows streetcar Number 29 as it appeared at some point towards the end of the Second World War. The curved window tops should be noted. It is also important to note that the paint scheme, steps and other exterior details not described previously were added between the time the streetcar was built and the time the photograph was taken.

Freight and Service Equipment, 1911

At some point before October 1911, the ERR decided that it required a sand car. A sand car was a streetcar that could be used to distribute sand along the right of way as well as being able to deliver sand to other streetcars in service. The earliest available Street Railway Department Monthly Report (October 1912) notes that there were thirty passenger streetcars in addition to one sand car in operation on the ERR during October 1911. A press report of November 1911 also states that there were only thirty passenger streetcars in service. (Railway and Marine World, p. 1071) It seems likely that the single truck streetcar Number 7 was used as the sand car since it was subsequently used for overhead line maintenance and construction purposes.

Equipment Modifications, 1911

It was mentioned in a previous section that in 1909, the first ERR sweeper was heated with a wood and coal burning stove. The reason for using a stove instead of electric heaters had been to reduce the sweeper's demand for electricity since there was a power shortage on the ERR at that time. During 1910, the Calgary Municipal Railway replaced the electric heaters in some of its passenger streetcars with a newly developed coal and wood burning forced air heater. This was done for two reasons. Firstly, that system also suffered from a power shortage and, secondly, it was much cheaper to heat the streetcars in this fashion. The heaters, however, required a smoke stack and the sight of smoke coming from a passing streetcar was not considered esthetically pleasing by some citizens. (Edmonton Bulletin, October 15, 1910)

The ERR, nevertheless, took great interest in these heaters because it was in the midst of a severe power shortage. The Superintendent visited Calgary to view the heaters in operation and in early 1911, the ERR installed a similar heater on one of its streetcars. (Edmonton Journal, May 2, 1911, p. 12) The heater, which was obtained from the Peter Smith Heater Company of Detroit, Michigan, consisted of a small cast iron stove (sometimes called a fire pot) and ash pit which was surrounded by two square sheet steel cabinets, one inside the other. The top of the larger cabinet supported a small electric motor which rotated a squirrel-cage blower. The blower, when in operation, drew cold air into the outer cabinet and forced it into the smaller cabinet where it was heated. A duct which was connected to the inner cabinet distributed the heated air along one side of the streetcar body at floor level. In this manner, the air inside the streetcar was being constantly circulated and warmed. A stove pipe led from the stove through the roof of the streetcar where smoke and gases could escape. (Electric Railway Journal, December 3, 1910, pp. 1105-1106) Figure 37 (after Drawing in Electric Railway Journal, p. 1106) shows the cross-sectional appearance and operating principles of a Peter Smith model 2-P heater.

The operation of the Peter Smith heater was considered to be more efficient and less expensive than the electric heaters. By the end of October 1911, all ERR streetcars, including work and service equipment, were equipped with one model 2-P Peter Smith heater each. (SRDGL, Account C6) In most instances, the heaters appear to have been installed near one end of the streetcar body. (Photographs in the Author's Collection)

During 1911, the ERR experimented with different methods of route identification on their passenger streetcars. In the past, the streetcars carried reversible boards which had the name of a destination painted on each side. Such a sign may be seen in Plate 23. These signs were not readily visible at night. The ERR management decided to experiment with roof-mounted illuminated signs which contained a roll of black colored

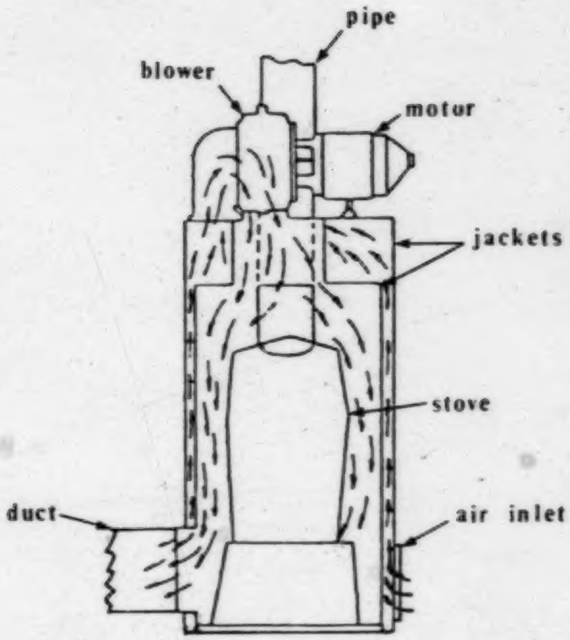


FIGURE 37. PETER SMITH HEATER

canvas which had the destinations silkscreened in white lettering. In addition, two colored marker lamps installed at both ends of the streetcar would provide a color code for each route. The marker lamps were thought to be visible from a greater distance than the lettering on the signs. Only one passenger streetcar was fitted with colored marker lamps in 1911. The lamps, which were obtained from the Boston, Massachusetts firm of Peter Gray and Sons, were small sheet metal boxes which had a colored lens on each of four adjacent sides. The bottom of the lamp was affixed to the hood of the streetcar while the top contained a housing for an incandescent bulb. (SRDGL, Account C6, and Edmonton Bulletin, October 26, 1911) As many as four different colored lenses could be installed on each lamp. The box area around the lenses were painted the same color as the lens. In this manner, the route color could be seen during daylight hours. A handle protruding into the vestibule enabled the lamp to be rotated until the desired color was facing forward.

The illuminated signs and the colored marker lamps were considered to be superior to the reversible signs so the ERR management decided to equip all passenger streetcars in service with them. This general conversion, however, did not begin until 1912. (Railway and Marine World, January 1912, p. 41)

Passenger Equipment, 1912

In February 1912, the Cities of Edmonton and Strathcona were to be amalgamated. Part of the Edmonton Strathcona Amalgamation Act called for the construction of several new streetcar lines by the City of Edmonton in the former City of Strathcona. Some of the new lines were to be in operation by the end of 1912. (Statutes of Alberta, 1911-1912, Chapter 66, pp. 529-531, see also Chapter III) In addition, several new track extensions in Edmonton were to be built. In order to have enough rolling stock to operate these new lines, the City of Edmonton ordered fifteen new streetcars. It was imperative that these streetcars arrive in Edmonton before the end of 1912. These streetcars were ordered from the St. Louis Car Company. That company guaranteed delivery of all fifteen streetcars by the middle of June or it would pay the City a monetary penalty for each day that delivery was delayed. (Agreement between the St. Louis Car Co. and the City of Edmonton, February 9, 1912, pp. 1-2) To enable these streetcars to be used for short turn service and on stub lines, the streetcars were constructed as double end units.

Unlike the previous thirty-one passenger streetcars, the side, end and intermediate sills of the St. Louis streetcars were composed entirely of steel channel, bars, and angles which were riveted together. Additional wooden sills were added to facilitate the attachment of the sides and floor. (St. Louis Car Co. Specifications of Streetcars, January 20, 1912, pp. 1-2) A steel underframe gave the body and the vestibule greater strength and eliminated the need for truss rods. Although streetcars fabricated entirely of steel were available, such vehicles were much heavier than composite wood and steel cars. It is doubtful as well whether the ERR's temporary track construction could have withstood the weight of all steel streetcars.

The bodies of the St. Louis streetcars were constructed in a similar manner to the other ERR streetcars except that the roofs of the St. Louis cars did not have monitors; a flat arch roof was selected instead. To allow for ventilation, the vestibule hoods were placed so that they were attached to the bulkheads a few inches (mm) below the level of the body roof. Special steel ventilators were placed at each end of the streetcar between the top of the hoods and the bottom of the body roof. In order to protect the canvas on the roof from damage by the boots of service crews, a running board (several strips of pine or oak placed longitudinally) was placed along the centre of the body roof. (St. Louis Car Co. Specifications, p. 2) Cost reduction was the prime reason why the ERR selected the arch roof for these streetcars instead of a monitor roof which was available. (Agreement between the St. Louis Car Co. and the City of Edmonton, February 9, 1912)

The eleven body windows on each side, which were square in shape, slid into pockets in the ceiling since there was considerable space available there. It should be noted that because there were no sash pockets in the wainscoating, there was only an extremely small air space between the wainscoating and the body framing. This lack of insulation tended to increase the heat loss from these streetcars. In subsequent years, the ERR received many complaints that these streetcars were much colder than other streetcars on the system. (Letter to the City Commissioners from ERR Superintendent W. J. Cunningham, January 23, 1928, p. 2) In order to protect the external sheathing of the body from blows and sideswipes from road vehicles, a steel pipe called a bumper rod was placed along the bottom of the sheathing on each side of the body. The pipe was secured to the underframe with bolts. (St. Louis Car Co. Specifications of Streetcars, January 1912, p. 9)

The seating in these streetcars was laid out in the same fashion as the seating in streetcars 10, 12, 14 and 16. In addition, the St. Louis cars had hand poles suspended horizontally above each longitudinal seat with steel brackets. Leather straps attached to the hand poles enabled those passengers who were standing to hold onto something substantial. (St. Louis Car Co. Specifications, pp. 4-5) In the past, standees had to hold onto seat handles or onto the bulkheads. A seat for the motorman was to be placed in each vestibule. The seat assembly, which consisted of a small wooden seat which was supported on an adjustable steel pole, was not found on the earlier ERR streetcars. (St. Louis Car Co. Specifications, p. 5) The interior lighting of these streetcars consisted of a line of single bulbs placed along the centre of the ceiling. The light was evenly distributed throughout the interior because there was no monitor or other obstructions in the ceiling. A total of fifteen bulbs were installed in the body of each streetcar, while there was one bulb in each vestibule.

The interior signal system included both a rope and hammer gong arrangement as well as electric bells which were operated from push buttons located in the window posts beside each seat. The electric bell system for these streetcars was designed to operate using trolley voltage, thus saving the cost of replacing dry cell batteries. (St. Louis Car Co. Specifications, p. 6)

Illuminated signs, manufactured by the Hunter Company, were installed on both hoods of each streetcar as well as on the roof in the middle of each side. Each sign contained one incandescent bulb for illumination, in addition to a length of silkscreened canvas that was moved by an arrangement of geared rollers. Two marker lamps, manufactured by Peter Gray and Son, were placed at both ends of each streetcar on either side of the illuminated sign. Each marker lamp held four lenses. Their colors were: red, green, blue and clear. Each marker lamp was illuminated by a single incandescent bulb. All the bulbs on the streetcars, with the exception of the headlights, were 16 candle power (20 W) incandescent bulbs. (St. Louis Car Co. Specifications, pp. 7-8) The marker lamps and the hood-mounted illuminated signs were protected from the trolley pole by a steel framework which also included a hook to hold down the trolley pole when it was not required. (Plate 26)

A single arc headlight was supplied with each streetcar. These arc headlights were designed to be portable. They were mounted on the dashes of the streetcars by means of hooks which fitted into a bar which was bolted to the dash. Two bayonet plugs (an insulated housing which accepted a straight section of copper or steel bar) located either directly below the bar or immediately below the bunter enabled the headlight wires to be connected to the power supply. When the streetcar was to reverse its direction of travel, the motorman or the conductor would unplug the headlight, unhook it from the dash, and reinstall it at the opposite end. In addition, such headlights could be removed during the day, thus reducing the likelihood that they would be damaged. (St. Louis Car Co. Specifications, p. 8)

The vestibules, which were designed for PAYE fare collection, were each approximately 7 feet (2 134 mm) in length. The vestibules were sheathed below the belt rail, on the exterior, with number 12 gauge sheet steel. Inside, the vestibules were finished in natural cherry above the belt rail and with number 16 gauge sheet steel below the belt rails. (St. Louis Car Co. Specifications, pp. 1-4) Single tread folding steps were installed at two diagonal corners of the streetcar. The folding steps were lowered by a lever assembly which also opened the doors above the steps. It should be noted that the other two doors were single width sliding doors which had a single tread fixed step below them. These doors were intended for use by passengers who were leaving the streetcar. (St. Louis Car Co. Specifications, p. 3) The folding doors had grab handles mounted on the inside in order that they would be available only when the doors were open. The grab handles for the sliding doors were located directly inside the vestibules. The placement of the grab handles, as well as the use of folding steps, prevented passengers from boarding the streetcar from the wrong side, or from boarding the streetcar once it was underway.

The fifteen St. Louis streetcars were to be equipped with two Brill 27-GE-1 trucks each but St. Louis 47-B trucks were used instead. This came about because the St. Louis Car Company agreed to reduce the total price of the contract if their own trucks were used, thus providing advertising for the products in Western Canada. (Letter to the City Commissioners from J. I. Beggs, St. Louis Car Co. President, March 11, 1912) The 47-B truck was similar in appearance to the Bemis 45 truck. The 47-B truck, however, used two small elliptical springs to support the truck bolster instead of large leaf springs. (St. Louis Car Co. Drawings of 47-B Truck, 1912) The 47-B trucks, therefore, were somewhat smoother riding than the Bemis or the Brill trucks.

The color scheme of these streetcars was similar to the color scheme of streetcars 24 through 31. There were some differences, however. The name "Edmonton Radial Railway" was placed on the letterboards instead of below the belt rails on the sheathing. In addition, a 1 inch (25.4 mm) high gold stripe was painted along the entire length of each side of the body 2 inches (51 mm) above the bottom of the sheathing. The streetcars were numbered 32 through 46 and were sent to Edmonton without motors or air brake equipment. (St. Louis Car Co. Specifications of Streetcars, January 1912, pp. 6-8) All fifteen units were delivered to Edmonton by the end of June 1912. (SRDMR, May-June, 1912)

The motor and control equipment was furnished by the Canadian General Electric Company while the air brake equipment was supplied by the Canadian Westinghouse Company. (Canadian General Electric Co. Contract for Equipment, February 1, 1912, and Railway and Marine World, March 1912, p. 150) These streetcars were also wired so that they could be equipped with an ammeter that would record the power used by the motors, thus providing an estimate of power consumption. (St. Louis Car Co. Specifications of Streetcars, January 1912, p. 8) The ERR purchased the meters from the Ferranti Meter and Electric Company of Montreal. The use of these meters was a dismal failure because the extreme temperature fluctuations in Edmonton caused them to jam. (CECR No. 211, October 1, 1915)

One Peter Smith heater was installed in each streetcar before the end of 1912. (SRDGL, Account C6) While the stoves were installed inside the car bodies, the smoke stacks were placed in the hoods. This was done because a smoke stack placed through the body roof would have interfered with the opening of the windows since they slid into the ceiling.

Plate 26 (Provincial Archives of Alberta) shows the appearance of streetcar Number 44 at some time during 1913. The following should be noted: marker lamps at both ends, illuminated signs, running boards, folding steps, fixed step, and the smoke stack. It should also be noted that the message "Have Exact Fare Ready" was added in 1913.

Freight and Service Equipment, 1912

By 1912, the ERR had an established freight handling business. Part of the freight service involved the movement of railroad boxcars and flatcars from the steam railroads to businesses located along ERR lines. (CEAR, 1912, p. 207) None of the ERR's rolling stock was well suited for this task. In addition, no ERR rolling stock could transport long sections of rail which were required for track extensions. In early 1912, therefore, the ERR ordered one "work car" from the Mc-Guire-Cummings Manufacturing Company. (Railway and Marine World, March 1912, p. 150, and SRDGL, Account C6B)

The "work car" was a motorized flat car. The frame was fabricated of steel and was placed on two McGuire-Cummings type 10-A MCB trucks which were the same type of trucks that were applied to the ERR's combination baggage car and sweeper. A wooden deck was then attached to the top of the frame. A small wooden cab was placed at one end of the deck. The cab rested on small posts which were placed at each corner of the cab. By having the cab floor raised above the deck, long sections of rail could be carried without the ends of the rails protruding beyond the length of the work car. (See Plate 7) Stake holders, provided by several steel brackets riveted to the sides of the frame, enabled loose loads such as lumber to be carried safely on the work car. Heavy draw bars with large coupler pockets were provided at both ends of the work

Plate 26. (Provincial Archives of Alberta) Streetcar Number 44 in 1913

JASPER
EDMONTON RADIAL RAILWAY

Plate 27. (Glenbow Archives) Streetcar Number 73 in 1914

car so that the unit could pull or push box cars and flat cars. The couplers for the unit conformed to MCB specifications but were not obtained and installed until 1913. (SRDGL, Account C6B) It is likely that chains were used to lash the work car to railroad rolling stock before the couplers were installed. (See Plate 7) From its appearance in Plate 7, in addition to specifications for later service equipment, it seems that the cab and frame of the work car were painted buff with black lettering and numbering. (ERR Specifications for Line Car L-1, 1913 and SRDGL, Account T13)

The motor and air brake equipment, which was obtained from the Canadian Westinghouse Company, was installed when the work car arrived in Edmonton. (SRDGL, Account C6B, and ERR Valuation Record, December 31, 1913 Plate 7 (Glenbow Archives) shows the ERR work car at the C. F. Taylor Lumber Yard at some point either in late 1912 or early 1913. The railroad box cars, the elevated cab, the stakes and the absence of a rear coupler should all be noted.

Equipment Modifications, 1912

It was mentioned in a previous section that in late 1911, the ERR had decided to install illuminated signs and marker lamps on all its passenger streetcars. This conversion work was begun in 1912 and entailed rewiring the lighting circuits of the streetcars. In most instances, a total of five series circuits with five lamps in each circuit were arranged in each streetcar. The markers, illuminated signs and the interior lamps comprised the apparatus in the circuits with the exception of two signs which were placed in the middle of the monitor on each side. These signs were illuminated by the interior lamps. A special three-way switch on one of the circuits enabled the motorman to extinguish the vestibule lamp or lamps when the streetcar was in motion. When the switch was set in this position, an additional body lamp or lamps was illuminated. In the case of a streetcar equipped with incandescent headlights, each headlight was wired into circuits, which included a vestibule lamp. When the three-way switch was set to one of the "on" positions, the vestibule lamp would be illuminated and the headlight would be off. When the second "on" position was selected, the vestibule lamp would be extinguished and the headlight illuminated. (ERR Light Wiring Diagrams, 1912-1913)

The installation of the illuminated signs and marker lamps enabled the ERR to make extensive repairs on some of the original streetcars. (CEAR, 1912, p. 206) A press report of November 23, 1911 noted that some of the streetcars had been stored out of doors because of insufficient room in the car barns and these cars were in need of some repairs because of this extensive exposure. (Edmonton Journal, p. 1) Although it is not known how many streetcars were repaired and repainted, it is known that streetcars 4, 5 and 6 were extensively overhauled during 1912. In this overhaul, these streetcars were converted to single end PAYE units. (ERR Valuation Record, December 31, 1913) The lengths of the rear vestibules on these streetcars do not appear to have been altered at this time. It should be noted that at some point between 1912 and 1914, the Brill trucks under streetcars 1 and 3 were exchanged with Bemis trucks taken from streetcars 10, 12, 14 and 16. (SRD Table of Car Weights and Levers, circa 1920, ERR Specifications of Line Car L-1, 1913, and SRDGL, Account F16H)

Exterior mounted rear view mirrors were installed on most ERR rolling stock beginning in 1912. These rectangular mirrors were manufactured by the Indianapolis Brass Company of Indianapolis, Indiana and were bolted to the right-hand corner post of each forward-travelling vestibule. (SRDGL, Account T13) The mirrors appear to have been installed on most work and service equipment with the exception of the sprinkler. (Plate 9, and Photographs in the Glenbow Archives and in the Provincial Archives of Alberta) The mirror enabled the motorman to see the right-hand side of the streetcar. This was important especially when a streetcar was making a right turn on a paved street with a curb. It was possible for a road vehicle to be caught between the streetcar and the curb as it turned the corner. If the streetcar did not stop, the vehicle could be severely damaged. The mirror enabled the motorman to watch for this hazard.

During this period, each streetcar was equipped with two kerosene lanterns which had red globes. (SRDGL, Account T13) A nail placed immediately below the belt rail on each vestibule held the lanterns. It should be recalled from a previous section that the City Commissioners ordered these lanterns to be carried because one streetcar had rammed another which had lost power on a darkened section of track. These lanterns were in use for a short period of time. By September, the ERR had decided to equip most of its passenger streetcars with arc headlights. (SRDGL, Account T13) It should be remembered that arc headlights had been used in 1910 but were discontinued because of heavy power consumption. The new arc headlights, manufactured by the Crouse-Hinds Company, were of the portable "luminous arc" variety. (SRDGL, Account T13)

The electrodes of a luminous arc lamp differentiated this type of headlight from traditional arc lamps. A luminous arc lamp was designed to use less current than ordinary carbon arc lamps. One electrode of a luminous arc lamp consisted of copper, while the other consisted of a mixture of magnetite, chromium and titanium which was packed in a small iron tube. (Doane & Parkham, 1926, § 22 pp. 26-27) The interior of a luminous arc headlight did not usually contain a reflector since the light produced by the arc was extremely bright. One luminous arc lamp was assigned to each streetcar and they were installed as the streetcars underwent rewiring for illuminated signs and marker lamps. (Photographs in the Author's Collection) As each streetcar received a luminous arc headlight, the kerosene lanterns could be dispensed with. (SRDGL, Account T13)

Two different brands of trolley catchers were purchased during 1912 and were installed on many of the passenger streetcars. Both types were found not to be strong enough and they were removed. (CECR No. 211, October 1, 1915) It should be noted that the sockets used to hold these catchers were left on many of the streetcars' dashes. (Photographs in the Author's Collection, and Photographs in the Glenbow Archives)

Passenger Equipment, 1913-1914

It was mentioned in Chapter II that the City Council in late 1912 gave its approval for the construction of several miles (km) of new track. At that time, it seemed as if the ridership on the ERR was going to continue to increase at a rapid rate. (CEAR, 1912, pp. 1-4 & p. 208) In order to accommodate the anticipated increase in ridership as well as providing service on the new track, the City Council approved the purchase of thirty-five additional streetcars. By the end of November 1912, the City had finalized a contract with the Preston Car and Coach Company for the supply of thirty-five streetcars. (Preston Car and Coach Co. Contract for Streetcars, November 20, 1912)

These streetcars were substantially different in appearance from the earlier ERR passenger streetcars. The bodies of these streetcars were to be 33 feet 3 3/4 inches (10 154 mm) in length, which was more than 3 feet (914 mm) longer than the bodies of streetcars 32 through 46. (Preston Car and Coach Co. Specifications of Streetcars, November 8, 1912, p. 1) Like streetcars 32 through 46, these Preston vehicles had steel frames. The frames of these streetcars, however, were more substantial than those found on streetcars 32 through 46. Larger steel angle bars were used on the Preston streetcars in addition to 6 inch (152 mm) high steel "I" beams for the intermediate sills, while 4 inch (102 mm) wide steel channel was used for the end sills. All parts of the body and vestibule frame were riveted together. (Preston Car and Coach Co. Specifications, pp. 1-2) The streetcars were to be single end so the front vestibule length was 5 feet (1 524 mm), while the rear vestibule length was 7 feet (2 134 mm) in order to accommodate the full PAYE system.

The flooring of these streetcars, with the exception of the grooved matting down the centre of the bodies, was composed of a double layer of 7/8 inch (22.5 mm) thick tongue and groove oak boards. (Preston Car and Coach Co. Specifications, p. 3, and Letter to ERR Superintendent W. Woodroofe from Preston Car and Coach Co., November 20, 1912) The interiors, including the vestibules, were finished in cherry. The seating arrangement, which was similar to the seating arrangment of streetcars 24 through 31, consisted of nine pairs of fixed cross seats. In addition, two 5 foot 5 inch (1 651 mm) long longitudinal seats were placed near the rear of each streetcar. Strap hangers were placed above the longitudinal seats. A Peter Smith heater and a sheet metal fuel box were installed on the left-hand side of the front vestibule. The heater was probably placed in the vestibule because little heat had reached the motorman in streetcars where the heater was installed inside the car body. (Preston Car and Coach Co. Specifications, pp. 6-7)

Each side of the streetcars were framed for twelve body windows which were square in shape and which were designed to drop into sash pockets in the wainscoating. The exterior window guards consisted of steel netting which covered the entire 24 inch (610 mm) sash opening. (Preston Car and Coach Co. Specifications, p. 5) The roofs on these streetcars were of the "turtle back" design. A turtle back roof was a type of symmetrical arched roof in which separate hoods were eliminated. The roofline was unbroken except for three evenly spaced ventilator ducts placed along each side. (See Plate 27) A running board composed of oak or pine boards was installed on each streetcar. The exteriors below the belt rails were sheathed with narrow V-joint poplar boards. The vestibules were not sheathed with sheet steel. The bottom of the body sheathing was protected by an iron pipe, as were streetcars 32 through 46. (Preston Car and Coach Co. Specifications, p. 4)

The doors, which were installed on the right-hand side only, were designed to fold. The steps were fixed single tread and were similar to the fixed steps applied to earlier ERR passenger streetcars. Marker lamps were installed on the roof at both ends but roof mounted signs were not used. Smaller interior signs that were installed in the upper part of the sashes were used instead. Such signs were less likely to be affected by snow and extremely cold weather. One sign was installed in the right-hand window of the front vestibule while another was installed in the right-hand window of the rear vestibule. These signs were illuminated by a single bulb each. Two similar signs were installed in the sixth (counted from the front vestibule) body window on each side. These signs, which did not contain bulbs, received their illumination from the bulbs in the interior of the streetcar. (Photographs in Glenbow Archives, and ERR Light Wiring Diagrams, 1912-1913)

The exterior finish on these streetcars was similar to the finish on streetcars 32 through 46 except that the numbers were placed near both ends of each bunter instead of on the dashes. (Preston Car and Coach Co. Specifications, p. 7) The streetcars were numbered 47 through 81. (SRDGL, Account C6A) A motorman's mirror as well as a luminous arc headlight were supplied with each unit. (Preston Car and Coach Co. Specifications of Streetcars, November 8, 1912, p. 6 & p. 8)

The weight of each body, without trucks, electrical equipment or air brakes, was approximately 22,000 pounds (9 979 kg). (Preston Car and Coach Co. Specifications, p. 1) These streetcars were much heavier than earlier ERR passenger equipment. Heavier trucks than the Brill 27-GE-1 trucks were required if these streetcars were to operate efficiently and smoothly. Number 0-50 trucks manufactured by the Standard Motor Truck Company of Butler, Pennsylvania were selected for these streetcars. (Preston Car and Coach Co. Contract for Streetcars, November 5, 1912, p. 1) The Standard 0-50 truck, which had a 4 foot 6 inch (1 372 mm) wheel base, consisted of heavy open hearth steel forged side and end frames which were riveted together. Unlike the Bemis 45 and the St. Louis 47-B trucks, the Standard 0-50 trucks also contained large equalizer bars which were connected to the journal boxes on each side of the truck. (Standard Motor Truck Co. Specifications of 0-50 Motor Truck, May 1912) An equalizer bar tended to dampen any bumps that the truck wheels encountered as they passed over the track. Large elliptical springs combined with the equalizer bars enabled these trucks to provide a smoother ride than the St. Louis and the Bemis trucks. Two 0-50 trucks were placed beneath each streetcar.

In order for the ERR to be able to place these streetcars in immediate service, the Preston Car and Coach Company was paid to install both the electrical and the air brake equipment before sending the units to Edmonton.

Although these streetcars had been constructed as single end vehicles, they were fitted with controllers and air brake valves for double end operation. (Canadian General Electric Co., Canadian Westinghouse Co., and Allis-Chalmers Co. Contracts for Electrical and Air Brake Equipment, 1912) Only one trolley pole was installed on each streetcar. It seems likely that the ERR installed double end equipment in these streetcars in direct response to a serious accident which occurred in June 1912. Many streetcars had been using a Y at the intersection of Kirkness (95th) Street and Alberta (118th) Avenue. On June 5th, a single end car was using the Y in order to travel south on Kirkness Street. The conductor had given the motorman the signal to back up. Immediately after the streetcar had started to move, a man on an adjacent sidewalk yelled to the conductor that a small child was on the track directly behind the streetcar. All the conductor could do was to give the motorman the stop signal. By the time the streetcar had stopped, the child had been killed. (Edmonton Bulletin, June 6, 1912, p. 12) Some citizens suggested, subsequently, that if the conductor had been able to apply the brakes, the death might have been prevented. (Edmonton Bulletin, June 8, 1912, p. 12) It is probable that double end equipment was installed to enable the motorman or conductor to control the streetcar from the rear vestibule during backing maneuvers.

The order for the electrical and air brake equipment was split unequally between three manufacturers, Allis-Chalmers, Canadian General Electric and Canadian Westinghouse. (Canadian Railway and Marine World, February 1913, p. 92) There was little difference in price between the proposals from Canadian General Electric and Canadian Westinghouse. The prices submitted by Allis-Chalmers were considerably higher because that firm manufactured its apparatus in Milwaukee, Wisconsin. (Canadian General Electric Co., Canadian Westinghouse Co., and Allis-Chalmers Co. Proposals for Electrical and Air Brake Equipment, 1912) The ERR was familiar with both General Electric and Westinghouse motors but was not familiar with General Electric air brake equipment or any motor or air brake equipment from Allis-Chalmers. In order to try these new equipments, the ERR ordered three sets of motor and air brake equipment from Allis-Chalmers (through its Canadian office, Allis-Chalmers-Bullock), ten sets from Canadian General Electric and twenty-two sets from Canadian Westinghouse. (Allis-Chalmers, Canadian General Electric, and Canadian Westinghouse Contracts for Motor and Air Brake Equipment, 1912-1913)

The Allis-Chalmers equipment, which was installed on streetcars 47 through 49, consisted of four type 301, 40 H.P. (29.8 kW) motors. (ERR Valuation Record, December 31, 1913) These motors were similar in appearance and operation to both the GE-80A and the Westinghouse 101-B motors. The gear ratio that was used with the type 301 motors was 15 to 69 and provided the same motor speed reduction as the gears used with the GE-80A-1 and with the Westinghouse 101-B-2 motors. (Allis-Chalmers Co. Specifications of Type 301 Motor, 1910, p. 3) Two Allis-Chalmers type S-4 controllers, which were similar in appearance and operation to K-6 controllers, were installed in each streetcar in addition to two lightning arrestors near each controller and a single trolley pole which was placed on the roof directly over the rear truck. The air brake apparatus for these streetcars was similar to the Westinghouse equipment. One Allis-Chalmers type AA-7 air compressor supplied the compressed air for each unit, however, The AA-7 air compressor produced a greater volume of compressed air per minute than the Westinghouse D-1-EG compressor. The AA-7 unit, however, had more moving parts. (Allis-Chalmers Co. Specifications of Equipment, September 1912, and Drawing of S-4 Controller and Wiring Diagram, 1910)

The ten sets of General Electric motors, installed on streetcars 50 through 58 and on streetcar 63, consisted of the same type of motors, controllers and auxiliary apparatus which had been installed on earlier ERR passenger streetcars equipped with General Electric equipment. (ERR Valuation Record, December 31, 1913) The air brake equipment included one C.P. 27-A compressor which was similar in operation to the Westinghouse D-1-EG compressor. The General Electric unit had a different external appearance. (Canadian General Electric Co. Contract for Equipment, January 1913, p. 3)

The twenty-two sets of Westinghouse motor and air brake equipment, which were identical to the Westinghouse equipment installed on other ERR passenger streetcars, were installed on streetcars 59 through 62 and on streetcars 64 through 81. (Canadian Westinghouse Co. Contract for Equipment, 1912, and ERR Valuation Record, December 31, 1913)

All of these Preston built streetcars were equipped with pneumatic sanders operated from the front vestibule, and hand brakes with handles located in both vestibules. It is important to note that "staffless" brakes were installed on these streetcars. (Preston Car and Coach Co. Specifications of Streetcars, November 8, 1912, p. 8) It should be recalled that the older type of handbrake employed a vertical staff with a large handle on the top which was used to apply the brakes. The brakes were held in the "on" position by a large ratchet gear and pawl (dog) which were located on the floor of the vestibule. If someone accidentally released the dog while the brakes were on, the handle on the brake staff would revolve rapidly, possibly striking someone and causing injury. The staffless brake consisted of a pedestal-like hollow iron casting which was bolted to the vestibule floor. A steel shaft installed horizontally in the casting, and protruding from the casting a short distance, enabled a large handwheel to be attached to it. Through gears attached to the shaft, the action of rotating the handwheel was transmitted to another shaft which supported a spirally-shaped casting to which a chain was attached. In addition, the shaft also rotated a ratchet gear which engaged a pawl that was controlled by a small foot pedal at the base of the casting. The chain passed through the bottom of the casting, over a pulley, and was connected to the brake beam. (Electric Railway Journal, 1911, reprinted in Traction Heritage, September 1975, pp. 37-38) The action of the staffless brake was such that the pawl could not be released unless the handwheel was rotated in a clockwise direction a short distance in order to release the gear pressure on the pawl. Staffless brakes, therefore, reduced the likelihood of accidental brake release and bodily injury. In addition, 12 inch (305 mm) diameter foot gongs were placed beneath the floor of both the front and rear vestibules. (Preston Car and Coach Co. Specifications of Streetcars, November 8, 1912, p. 7)

Delivery of these streetcars, referred to by most ERR personnel as "big Prestons", began in May 1913 with number 47, 48, 49, 51, 52 and 53. Streetcars 50 and 54 through 74 were delivered between June and October. (SRDGL, Account C6A) It appears that each streetcar was sent to Edmonton as it was completed by the builder. It seems likely, therefore, that only nine sets of General Electric equipment were available when streetcars 50 through 59 were completed. This would explain why streetcar Number 63 (which was delivered in September) instead of Number 59 was the tenth streetcar to be equipped with the General Electric equipment. (SRDGL, Account C6A, and ERR Valuation Record, December 31, 1913) Streetcars 75 through 81 were not delivered until 1914. (SRDGL, Account C6A) In the words of ERR Superintendent W. Woodroofe, "Thirty-five of these cars were ordered, but on account of the traffic not keeping up to expectations, seven cars were left over to be delivered during 1914" (CEAR, 1913, p. 288). The remaining seven streetcars were delivered throughout 1914, the last ones reaching Edmonton in September. (SRDGL, Account C6A) The total weight of each complete big Preston streetcar was approximately 46,000 pounds (20 866 kg), the heaviest streetcars on the ERR at that time. (ERR Diagram of Resistance Wiring for 23 Ton Preston Car, June 1914) The thirty-five big Prestons gave the ERR a substantial surplus in passenger equipment since the maximum number of streetcars usually placed in daily service was approximately fifty-six. (Edmonton Journal, March 20, 1914, to July 31, 1914) There were seventy-nine passenger streetcars available for service between September and December. (SRDMR, January to December, 1914) It would be several years before the ERR purchased additional passenger rolling stock. Plate 27 (Glenbow Archives) shows streetcar Number 73 as it appeared sometime during 1914. The marker lamps, roof ducts, sash mounted sign, single trolley pole and the controller in the rear vestibule should be noted.

Freight and Service Equipment, 1913

It was mentioned in a previous section that passenger streetcar Number 7 had been used as a sand car since 1911. In an earlier chapter, it had also been stated that the streetcar had been fitted with a roof mounted platform in 1913 to enable it to be used for erecting trolley wires. (See Chapter IV) Evidently, this was a temporary arrangement because in January 1913 the ERR began to construct a service car specifically designed for overhead construction and maintenance. (SRDGL, Account C6B) This vehicle consisted of a plain wooden frame which was strengthened by four underslung truss rods. A wooden deck placed on the frame supported a small wooden cab in the centre which, in turn, supported a wooden platform containing a small central section that could be elevated several inches (mm). (ERR Drawing of Line Car L-1, 1913) Access to the platform was provided by ladders which were placed at both ends of the cab. The placement of the cab in the centre of the frame enabled large spools of trolley wire to be carried easily. In addition, a centre cab enabled the line car to be arranged for double end operation. Two Bemis type 45 trucks supported the line car. These trucks were taken from one of the Preston passenger streetcars 10, 12, 14 or 16. The line car was arranged for double end operation. Trolley poles were placed at both ends of the fixed platform. A K-6 controller was also placed at each end of the cab. (ERR Drawing of Line Car L-1, 1913) Only two GE-80A-1 motors were installed on the line car. (ERR Valuation Record, December 31, 1913) Both motors were placed on one truck, which was a similar arrangement to the motor placement on the Preston sprinkler car. If only one motor were installed on each truck, the trucks would be unbalanced and would tend to derail. The line car was also equipped with a set of Westinghouse straight air brakes in addition to staff hand brakes. (ERR Drawing of Line Car L-1) A General Electric portable arc headlamp was installed on the line car. This headlamp could be hooked onto either end of the frame and received its power from plugs which were mounted on the underside of the frame.

(SRDGL, Account C6B, and Photographs of Line Car in the Provincial Archives of Alberta) It is significant to note that line car L-1 was the first unit of rolling stock which was fabricated by the ERR. (CEAR, 1913, p. 288) Plate 15 (Provincial Archives of Alberta) shows line car L-1 on the High Level Bridge sometime between April and August 1913. The Bemis trucks, platform, the spool of trolley wire and the lack of motors on the rear truck should be noted.

By 1912, the ERR management believed that it was losing freight revenue by not being able to haul large quantities of loose material such as gravel, earth and bricks. In addition, the lack of rolling stock which could haul and distribute large amounts of such commodities severely impeded the ERR's ability to deposit ballast along its temporary track. Horse drawn wagons had been used for this purpose in the past. Each wagon could move only a small amount of ballast at a time since one or two horses could not move heavy loads. (See Chapter III, and Photographs of ERR Track Construction in the Provincial Archives of Alberta) Therefore, in October 1912, the ERR ordered a Simplex differential dump car from the Canadian Car and Foundry Company of Montreal. (Canadian Railway and Marine World, November 1912, p. 572)

This unusual item of rolling stock consisted of a narrow steel frame mounted on two trucks which supported a segmented steel bin which could be tipped towards either side of the frame, thus allowing the contents of the bin to spill onto the ground. (See Plate 28) This type of car was referred to as a differential dump car because the bin could tilt to either side. The segmented steel bin was attached along its centre to the dump car frame by a long hinge. A patented system of levers fabricated by the Simplex Company controlled the bin's position. The sides of the bin consisted of steel doors which were hinged along the bottom and which were held against the bin at the top by hinged clamps. When the dump car had been loaded and had reached its destination, the crews could adjust the levers so that the doors on one side of the bin opened and the bin tilted towards that side. Gravity would then act upon the contents of the bin, thus dumping them onto the ground. A small wooden cab was placed at one end of the frame to house the electrical controls.

Two heavy-duty freight trucks, manufactured by Canadian Car and Foundry, were installed under the dump car. These trucks, designated Class 110 freight, possessed a 6 foot 6 inch (1 981 mm) wheel base and were fabricated of thick steel bar stock which was riveted together. Trucks constructed to this shape were commonly referred to as "arch bar trucks". Small coil springs placed between the truck bolsters and the side frames provided only rudimentary shock absorption. A narrow board was attached between the journal boxes on each side in order to protect the trucks from accidental blows by rocks or bricks as they were dumped. Heavy cast iron wheels, each with six evenly spaced spokes, were installed on the axles. In spite of the long wheel base, for greater truck stability, the motors were outside hung as they had been on the shorter wheelbase trucks found on the ERR. (Drawing of Class 110 Freight Truck, 1909) A total of four GE-80A-1 motors were installed on the dump car. (ERR Valuation Record, December 31, 1913) They were operated by a single K-6 controller which was located in the cab. General Electric train air brake equipment, in addition to couplers at both ends of the frame, enabled the dump car to move railroad rolling stock with ease and safety. (SRDGL, Account C6E)

The dump car was also equipped with incandescent headlamps on both ends of the cab and a gravity operated sander which deposited sand on the right hand rail. (See Plate 28) The dump car was painted, lettered and numbered before it was delivered to the ERR. The lettering consisted of the name "Edmonton Radial" placed on the front of the cab and the designation "S-5" placed on both sides and the front of the cab. Although the dump car was constructed as a single end unit, the trolley pole could be swivelled around. In this way, the dump car could travel backwards great distances. Plate 28 (Glenbow Archives) shows S-5 dumping a load of bricks near the site of the Highlands School during 1913 or 1914 after backing along the spur placed on Grace (62nd) Street. (See Chapter III and Map 7)

Several City administrators, in early 1913, believed that an additional sprinkler car was required immediately in order for the ERR to be able to keep the accumulation of filth to a minimum on all the paved streets it traversed. In early April, the City finalized an agreement with the McGuire-Cummings Manufacturing Company for the supply of one "turbine" model sprinkler car. This manufacturer was selected because it agreed to deliver the sprinkler by May 17 when it was thought it would be required. (McGuire-Cummings Manufacturing Co. Contract for Sprinkler Car, April 9, 1913)

The frame of this unit, unlike the sprinkler built by the Preston Car and Coach Company, consisted of steel channels and "I" beams which were riveted together. The liberal use of large "I" beams enabled the builder to dispense with truss rods since they would be superfluous. The tank, which consisted of steel plates riveted together, was 78 inches (1 981 mm) in diameter and was approximately 18 feet (5 486 mm) in length. Its capacity was 5,000 United States gallons (18 927 L). (McGuire-Cummings Co. Specifications of "Turbine" Sprinkler, March 1913, pp. 1-2, and CEAR, 1913, p. 288) Although the tank on this sprinkler car

Plate 28. (Glenbow Archives) Differential Dump Car S-5

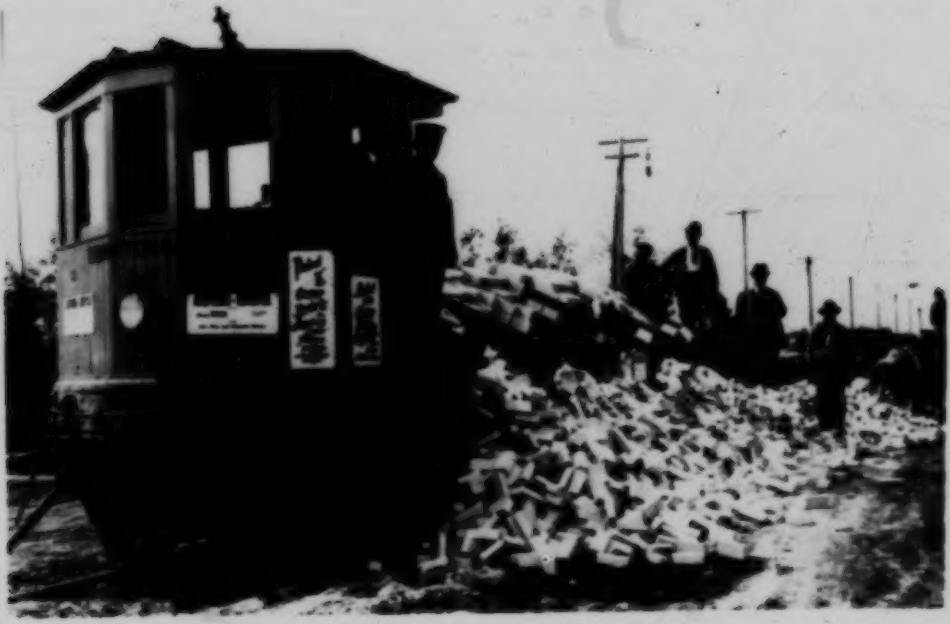
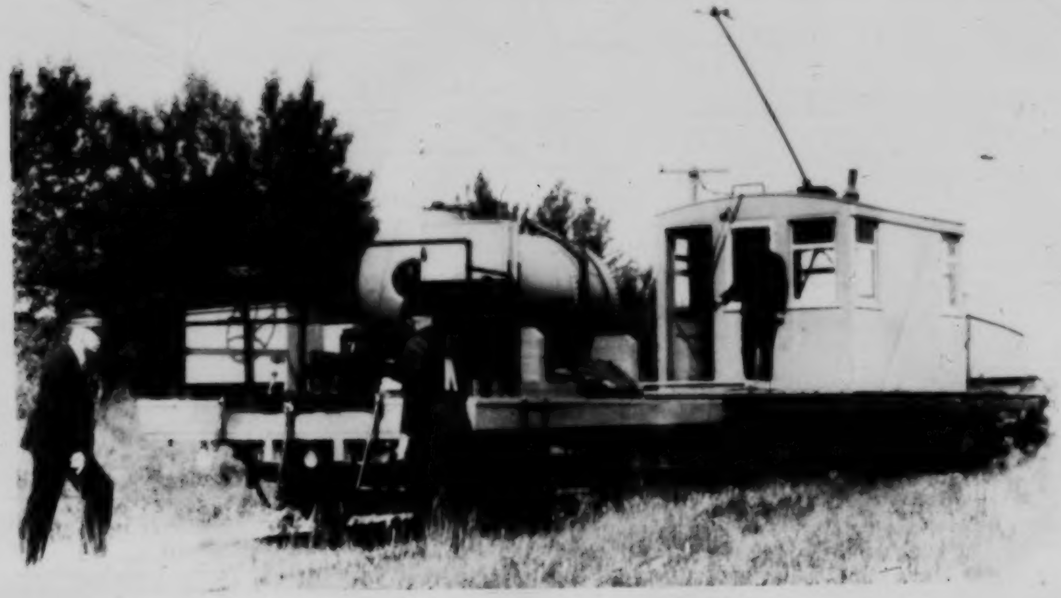


Plate 29. (City of Edmonton Archives) Sweeper Number 2 Pulling Weed Killer Car



was wider, it had a smaller capacity than the tank on the Preston sprinkler car. The tank on the McGuire-Cummings unit was secured to the frame with steel bands in a similar fashion to the Preston sprinkler. Canvas covered wooden hoods were installed between the ends of the tank and stanchions placed at the ends of the frame. Metal dashes, placed at each end of the frame, protected the crews and the control apparatus from the elements. (McGuire-Cummings Co. Specifications, p. 2)

The sprinkler was placed on two McGuire-Cummings S-E 60 motor trucks, a type of arch bar truck which resembled the Canadian Car and Foundry Class 110 freight truck. The wheelbase of the S-E 60 truck, however, was 4 feet 6 inches (1 372 mm). The ERR standard 34 inch (864 mm) diameter rolled steel wheels were placed on the axles. (McGuire-Cummings Co. Specifications, p. 3) The sprinkler came equipped with pneumatic sanders, staff hand brakes, 10 inch (254 mm) diameter foot gongs at both ends, and a heavy-duty centrifugal pump and electric motor which was designed to pressurize the tank. (McGuire-Cummings Co. Specifications, pp. 1-3) In addition to sprinkler heads at each end of the unit, a hinged steel arm was attached to the frame of the unit on one side. This arm, which could be swung out towards the curb, held four nozzles which were designed to spray pressurized water as close to the curb as possible, thereby forcing the filth against the curb. (McGuire-Cummings Co. Specifications, p. 2, and Photographs of Sprinkler S2 in Glenbow Archives) The sprinkler was painted and lettered before it was sent to Edmonton. The name "Edmonton Radial" was placed on each side of the tank. In addition, the designation "S2" was painted on either side of the name as well as near the edges on both dashes. (Photographs of Sprinkler S2 in Glenbow Archives) The installation of motor and air brake equipment took place in Edmonton.

The sprinkler was equipped with four Westinghouse 101-B-2 motors and two K-6 controllers. Current was collected from a single trolley pole placed on top of the tank near its centre. Westinghouse straight air brake equipment was also installed on this unit. (SRDGL, Account C6F, and ERR Valuation Record, December 31, 1913) The older style of rigid fender had to be applied to this sprinkler because there was insufficient room between the extremities of the frame and the front of the trucks to allow the installation of an HB lifeguard which was normally installed on ERR rolling stock. The ERR also equipped the unit with an arc headlamp. (Photographs of Sprinkler S-2 in Glenbow Archives) It is significant to note that Sprinkler S-2 was the final unit of manufactured freight rolling stock purchased by the ERR for use on its street railway. (See Appendix I)

Equipment Modifications, 1913-1914

In June 1913, construction was completed on a new car barn and maintenance facility in Edmonton's Cromdale district, at Beech (117th) Avenue and John (80th) Street. (CEAR, 1913, p. 288) The Cromdale car barns contained several pieces of heavy machinery which were designed to facilitate streetcar maintenance. Part of the machinery included one 42 inch (1 067 mm) wheel turning lathe and one 250 ton (226 800 kg) wheel press. (Woodroofe, 1914, p. 24) These machines enabled the ERR to undertake their own repairs on axles and wheels. The services of the Canadian Northern Railway, therefore, were dispensed with.

The new car barns also included a carpentry area which could accomodate two streetcars at a time and a paint shop with a capacity of six streetcars at a time. (Woodroofe, 1914, p. 23) The new shops enabled the ERR to undertake extensive repairs on streetcars without disrupting the movement of streetcars through the car barns. Apart from routine repainting and revarnishing, the paint shop was used to add lettering to several passenger streetcars during this period. In an effort to speed the service on the system, the statement "Pay As You Enter" was placed between the numbers located on the streetcars' bunters. In addition, the words "Have Exact Fare Ready" were placed on the exterior body sheathing near the rear doors on some streetcars. (SRDGL, Account T13, and Photographs in the Provincial Archives of Alberta)

The general conversion of the passenger fleet to illuminated signs and marker lamps also continued during this period. (SRDGL, Account T13) In addition, streetcars equipped with the bar type of window guard had them replaced by the same type of wire netting guards that had been supplied with the big Preston streetcars. (CECR No. 211, October 1, 1915) It had been discovered by the ERR that the wire netting was more effective than the bars in preventing passengers from sticking their appendages out of the windows.

In an effort to prevent motormen from wasting expensive electricity by accelerating the controllers too quickly, the ERR purchased and installed automotoneers on many of its streetcars' controllers. (SRDGL, Account T13) An automotoneer was a device which was attached to the top of the controller power shaft and which limited the speed at which the controller could be advanced. The automotoneer consisted of two steel castings, one of which was attached to the top of the controller with screws. This casting contained ratchet teeth around the circumference of its interior. This casting supported another casting which held several centrifugally operated pawls. The upper casting also held the power handle. The operation of an automotoneer was similar to the operation of a trolley catcher. If the motorman tried to advance the power handle too quickly, the pawls would swing out and would engage the ratchet teeth, thus preventing further advancement of the power handle until the motorman released pressure on the handle. The power handle could, however, be quickly returned to the "off" position since the ratchet teeth held the pawls in only one direction. The automotoneer prevented motormen from advancing the controllers too quickly, thus reducing strains on the motors and gears and reducing the amount of power consumed by the motors. (Doane & Parkham, 1926, § 22 pp. 34-36)

During 1913, gongs were installed beneath the rear vestibules of all single end streetcars on the ERR. (SRDGL, Account T13, Glenbow Archives Photograph ND-1328-1962, and Author's Inspection of Streetcars 13 and 31) These gongs were probably installed as the result of the Y accident in June 1912 which killed a young child who was playing directly behind a single end streetcar and did not hear it approach as it backed into the Y. In addition, the single roof mounted swing bell on the combination baggage/sweeper car was replaced by roof mounted gongs which were placed near each end of the unit. (SRDGL, Account T13, and Photographs in Author's Collection)

In 1914, the ERR experimented with a type of 40 H.P. (29.8 kW) motor which had a much lighter weight than the older types of motors then in use on the ERR. The motor was the GE-67A which was physically smaller than the GE-80A. (General Electric Co. Specifications of GE-67A Motor, 1909, and Specifications of GE-80A Motor, 1910) The GE-67A motor was not a heavy duty motor and was not designed to withstand the loads that could be placed on a GE-80A motor. (General Electric Co. Bulletin 4421A, January 1907, p. 1) Four GE-67A motors were installed on one of the big Preston streetcars in 1914 in an attempt to reduce the extreme weight of this type of streetcar, thereby reducing the destructive effects on the track and roadbed. (ERR Wiring Diagram of 23 Ton Preston Streetcar with a 4 GE-67A-1 Motors, 1914) The opening of the High Level Bridge in August 1913 meant that several streetcar routes could avoid the steep grades which led to and from the Low Level Bridge. (CEAR, 1913, p. 288)

The smaller size of the GE-67A motor meant that a smaller pinion gear had to be used with this type of motor if the ERR's standard 69 tooth axle gear was to be used. The smaller pinion gear, therefore, contained fifteen teeth. The gear ratio of 15 to 69 was considered the standard ratio for the GE-67A motor. The full classification of this motor was GE-67A-1. (General Electric Co. Specifications of GE-67A Motor, 1909) The K-6 controllers were not altered since their maximum capacity was four 40 H.P. (29.8 kW) motors.

Although the use of the GE-67A-1 motors reduced the weight of the big Preston streetcar, it seems that the motors could not propel the streetcar satisfactorily. The motors were probably removed during 1915 since there were no further references to their use.

The new Cromdale car barns carpentry area undertook the rebuilding of one vestibule on streetcar Number 14 after it had experienced a mishap with a train in late 1913. The rebuilding took several months. (SRDGL, Account F16H) The rebuilt vestibule was somewhat shorter than it had been originally. In addition, the rebuilt vestibule had an extremely narrow letter board while the undamaged vestibule contained a wide letter board. During this repair, Number 14 was converted to single end operation. (Photographs of Streetcar 14 in Glenbow Archives)

Equipment Disposal, 1913

Streetcar Number 23, which was struck by a train in September 1913, could not be repaired economically. A railroad gondola car had broken the side and the intermediate sills as well as most of the window posts. (Photographs of Wreck in Glenbow Archives) The loss of one passenger car was later reflected in the ERR monthly reports. (SRDMR, September 1913 to October 1914, and SRDGL, Account C6A) Although a press report of January 17, 1916 stated that a streetcar "23" had overturned on 97th Avenue on January 16, it is unlikely that the number in that press report is correct. (Edmonton Journal, pp. 1-2) There were no recorded expenditures of any repairs to streetcar Number 23 in 1914 or in 1915. In addition, the ERR had a large surplus of streetcars by the end of 1913, as well as a large deficit. (CEAR, 1913, p. 288) It is most probable, therefore, that streetcar Number 23 was scrapped after its mishap in September 1913.

Freight and Service Equipment, 1914

In the 1913 Annual Report, ERR Superintendent Woodroofe stated, "there is no reason why in future all work cars should not be built by the Department [ERR], and thus keep the labor in the City" (CEAR, p. 288) In order to transport large objects such as boilers and girders within the City, an unmotorized flat car was required. Such a unit, unlike the motorized flat car, could be moved to a location and left there unsupervised for a considerable time while it was being loaded or unloaded. A press report of November 16, 1912 noted that the steel girders for the new Pantages theatre on Jasper Avenue were hauled to the construction site along ERR tracks by ERR motive power. The girders had been placed on steam railroad flat cars, however. (Edmonton Bulletin)

The ERR might have been able to secure additional revenue if it had possessed a flat car of its own at that time.

The construction of a flat car began in January 1914. The unit was completed by June. (SRDGL, Account C6C) No specifications or photographs have been located which provide any indication of the flat car's dimensions. The ERR's ledger, however, indicates that the unit was fabricated of wood with steel truss rods. (Account C6C) It is possible that the flat car was constructed to the same dimensions as the frame of line car L-1 since the drawings for that vehicle include an illustration of a reinforced wooden frame which did not possess a cab. (ERR Drawings of Line Car L-1, 1913)

It also seems likely that two Bemis type 45 trucks supported the flat car since there was no recorded expenditure for trucks. (SRDGL, Account C6C) In addition, the destruction of streetcar Number 23 in 1913 released a pair of Brill 27-GE-1 trucks for use. It should be remembered that the ERR had found the Bemis trucks unsatisfactory for passenger streetcars because of their rough riding qualities. It is highly probable that the ERR removed a pair of Bemis trucks from a passenger streetcar and replaced them with the surplus set of Brill trucks. The flat car was equipped with a brake cylinder, air hoses and couplers at both ends. (SRDGL, Account C6C) Service units S-4 and S-5 were probably used to move the flat car along ERR lines.

Freight and Service Equipment, 1915

During 1914, the ERR secured a contract for the transportation of mail between the post offices in Edmonton. (CEAR, 1914, pp. 54-55) It is probable that streetcar Number 7 was used for this purpose since it had been used for track sanding, overhead construction and similar work in the past. By May 1915, the Street Railway Department's Monthly Report no longer listed a sand car but listed an additional work car. (April-June 1915) It seems likely that the ERR had decided that a sand car was no longer required and that the single truck streetcar Number 7 was relegated to general work and service tasks.

Equipment Modifications, 1915-1924

Several trolley catchers were purchased during 1915 which were manufactured by the Earll Company of York, Pennsylvania. (CECR No. 211, October 1, 1915) These catchers, which were installed on several passenger streetcars, did not fail in service and were retained. Economic constraints prevented the ERR from equipping all of its rolling stock with this brand of catcher until the mid 1920's. (Letter to the Dominion Insulator & Manufacturing Co. from ERR Superintendent R. Colwell, November 14, 1924) It is of interest to note that some of the original Earll catchers remained in service until the end of street railway operations in September 1951. (Earll Trolley Catcher in Author's Collection)

The ERR had experienced considerable difficulty with the maintenance of the exterior finish on many of their passenger streetcars. Whenever the protective varnish wore away, the oil paints beneath had tended to lighten unevenly and to smear, giving the streetcar a shabby appearance. The ERR, because of financial constraints, found it difficult to keep the protective varnish coating in good repair on most of its streetcars. In consequence, the ERR decided to experiment with other types of paints and paint pigments that would resist weathering better than the metallic pigments that were found in the dark green and red paints then in use. ERR paint crews determined that the colors yellow and brown to be most resistant to weathering. The brown paint was to be applied to areas of the body and vestibules below the belt rail while the yellow paint was to be applied to the areas between the belt rail and the roof. In addition, extraneous gold lines and crests were to be dispensed with. (Edmonton Journal, September 24, 1915, p. 3) In this paint scheme, the roofs of the streetcars were to be painted white. (Edmonton Bulletin, June 1, 1926, p. 9) The lettering used with this paint scheme consisted of the abbreviation "E.R.R." which was centred on the letterboards on each side of the streetcar. The numbering consisted of a single number which was centred on each side of the body sheathing. (City of Edmonton Archives Photographs, and Photographs in the Author's Collection) A natural ochre was used by the ERR paint crews to fabricate the yellow paint. (SRDGL, Account T13) The ochre was thought to resist weathering better than metallic pigments. (Edmonton Journal, November 24, 1915, p. 1) The brown paint resembled Pantone ink shade 462C while the yellow paint resembled Pantone ink shade 123C. (Paint Fragments in the Author's Collection, and Pantone Matching System Book, 1980)

Four streetcars were painted in this livery by the end of 1915. (Edmonton Journal, November 24, 1915, p. 1) Streetcars 8, 18, 27 and 29 were repainted during 1916. (CECR No. 176, August 15, 1916) Most of the passenger streetcars were repainted in this livery by 1926.

By 1917, the ERR and the City were experiencing extreme financial difficulties. The situation was so acute that the ERR management had to apply to the City Council in order to receive funds for replacement spur gears for some of the motors. (CECR No. 160, August 27, 1917) In an attempt to reduce operating costs, the ERR began to convert some of their streetcars to one man operation beginning in April 1917. (Edmonton Bulletin, April 18, 1917, p. 3) It should be remembered that a crew of two men, a motorman and a conductor, had travelled with each streetcar in regular service in the past. The conductor normally had travelled in the rear vestibule and was responsible for fare collection and for the issuing and collection of transfer slips. One man operation entailed the motorman undertaking the conductor's duties as well as retaining his own duties. It was not possible for the motorman to collect fares from the rear vestibule since the streetcars were operated from the front vestibule. In order to facilitate one man operation, the streetcars had to be modified. Before the ERR could undertake extensive conversion to one man operation, permission had to be obtained from the BRC. The BRC gave its approval to the ERR for one man operation by April 17, 1917. (Edmonton Bulletin, April 18, 1917, p. 3)

Fare collection had to take place in the front vestibule since passengers would both enter and leave the streetcar through the front vestibule. The old PAYE system in the rear vestibule could no longer be used. To prevent passengers from using the rear doors, the ERR installed boards across the centre of the doors on the exterior and removed the rear steps. Initially, several streetcars were temporarily converted to one man operation in this manner, with the fare box being installed in the front vestibule adjacent to the motorman. In the meantime, the ERR was engaged in reconstructing several streetcars so that they would be better equipped for one man operation than the temporarily converted streetcars. (Edmonton Bulletin, April 18, 1917, p. 3, and Edmonton Journal, October 11, 1917, p. 1)

One of the ERR's innovations during this period was the creation of a double tread step in which the lower tread folded up by means of levers as the door was being closed. The double step reduced the distance an individual had to lift his or her foot in order to board the streetcar. (Canadian Railway and Marine World, March 1917, p. 113) The double step consisted of shaped steel hangers to which were bolted the upper wooden tread; the lower tread was hinged to the step riser. (See Plate 25) The lever mechanism used for raising and lowering the bottom tread had been adopted from the folding step mechanism which had been supplied with the fifteen St. Louis built streetcars. (St. Louis Car Co. Drawing of Folding Door and Step Mechanism, 1912) A vertically aligned steel pipe, which was placed in the front vestibule to the right of the motorman, was attached to two levers in addition to an operating handle. One of the levers opened and closed the folding door which was installed to the right of the motorman, while the other lever raised and lowered the folding tread in conjunction with the opening and closing of the folding door. The City Commissioners had expressed concern that the ERR may have infringed upon patents by using this type of mechanism with their double tread step. (Canadian Railway and Marine World, March 1917, p. 113) No litigation appears to have occurred and the step mechanism remained unaltered.

The ERR selected double end streetcars for conversion to one man operation since the ERR wished to install double-width folding doors on the right-hand side of the front vestibules in order to retain a type of PAYE system and to speed loading and unloading of passengers at each stop. In the conversion process, the single-width sliding door was removed and was replaced by a double-width folding door. A series of stanchions placed inside the vestibule guided entering passengers to the right where they paid their fares as they passed by the motorman. Exiting passengers used the left-hand half of the doorway. The front bulkhead had to be modified in order to accommodate this arrangement. A double-width opening was made in the bulkhead adjacent to the right-hand vestibule doors. The bulkhead door adjacent to the left-hand vestibule doors was replaced with a wood and glass panel. (ERR Drawing of Front Bulkheads) The rear vestibule was also modified. All of the entrance and exit doors, with the exception of one single-width door, were made inoperable. The single-width door was designed for emergency use only and was controlled by the motorman through a system of levers that ran underneath the frame of the streetcar. Several streetcars that were converted in this fashion were changed from double end to single end streetcars. In the case of such a conversion, one of the trolley poles and its base would be removed. In addition, rattan-covered seats were placed around the sides of the rear vestibule in order to provide additional seating. A small section of the seat, which was located directly in front of the emergency exit, was hinged and attached to the lever that operated the emergency door. When the emergency door was opened, the seat was supposed to swing up and out of the way of the emergency exit. (Edmonton Bulletin, June 9, 1917, p. 3) The rear bulkhead was unaltered since it was intended to isolate the rear vestibule from the streetcar body. Smoking was to be allowed in the rear vestibule. A mirror mounted inside the front vestibule enabled the motorman to observe the passengers inside the streetcar. (Edmonton Bulletin, June 9, 1917, p. 3)

The first streetcar to undergo extensive conversion to one man operation was Number 16, which was also converted to single end operation. This streetcar made its first run as a one man streetcar on June 8, 1917. (Edmonton Journal, June 8, 1916, p. 2) The car had been selected for conversion primarily because it had been involved in a mishap which damaged both vestibules. (Edmonton Bulletin, June 9, 1917, p. 3)

The ERR intended to convert all of its St. Louis built streetcars to one man operation because they possessed longer vestibules. A press report of June 12, 1917 noted that several motormen objected to this plan because they claimed that the St. Louis built streetcars were the coldest on the ERR and that it was likely that they would be colder in future. The motormen claimed that the heaters would be unable to keep the vestibules warm since the vestibules had not been warm in the past and would probably be colder with the installation of double-width doors. (Edmonton Bulletin, June 12, 1917, p. 3) In spite of these complaints, streetcars 32 through 46 were converted to one man operation. (Letter to the City Commissioners from ERR Superintendent W. J. Cunningham, February 18, 1926) It should be noted that only ten of the series (33-35, 37, 40-45) were converted to single end operation. (SRD Table of Car Weights and Levers, circa 1920) The five St. Louis built cars that were left as double end units had double-width doors installed in both vestibules. It should be noted that these streetcars did not have provision for smokers. (Letter to ERR Superintendent W. J. Cunningham from the City Commissioners, June 7, 1926) Seventeen one man streetcars were operating by October 1917 but most of these consisted of streetcars that had been temporarily converted for that purpose. (Edmonton Journal, October 17, 1917, p. 1)

At least one other double end streetcar was converted to single end one man operation during this period. A photograph of streetcar Number 12 taken in September 1919 indicates that it had been converted to single end operation. It is of interest to note that Number 12 had not been repainted and, therefore, did not appear to be in good repair. (Glenbow Archives Photograph ND-3-279) It appears that no double end streetcars with short vestibules or single end streetcars were fitted with double-width front doors during this period although the ERR abandoned two man operation by the end of 1920. (SRDAR, 1920, p. 2, and Photographs in City of Edmonton Archives) It was not too difficult for the ERR to install double-width doors on most streetcars that had been built for double end operation since these units possessed longer vestibules which could accommodate double-width doors. In order for the ERR to have installed double-width front doors on streetcars with short front vestibules, the vestibules would have had to be lengthened and completely rebuilt. The ERR was unwilling to undertake this difficult and costly task. Several photographs from this period depict streetcars with the double tread step, including some of the big Preston streetcars. None of the units so equipped possessed double-width front doors. (Photographs in City of Edmonton Archives and Photographs in Glenbow Archives) In addition, the ERR sold several surplus big Preston streetcars during this period. This type of streetcar was selected for sale because the ERR management felt that it would be too difficult to alter these streetcars for proper one man operation. (Edmonton Bulletin, July 6, 1917, p. 1)

It appears that the ERR was able to install the double tread step on streetcars that did not possess double-width front doors. On streetcars equipped with double-width doors, a single tread fixed step was installed. (Letter to the City Commissioners from ERR Superintendent W. J. Cunningham, February 18, 1926) It should be noted, however, that a single tread folding step was installed beneath the emergency exit. (Glenbow Photograph ND-3-279) It is likely that the step was lowered by the same lever arrangement which opened the emergency door and which raised the seat in front of the door. It is probable that the double-tread step could not be used with double-width folding doors because the extreme length of the treads would enable the folding tread to sag in the centre.

The streetcars that had single-width front doors were gradually fitted with folding doors, if they were not already equipped with them, and were fitted with the double tread folding step. By the end of 1925, forty-four of the ERR's seventy-two operable passenger streetcars were equipped with the double-tread folding step. (Letter to the City Commissioners from ERR Superintendent W. J. Cunningham, February 18, 1926)

During this period, the ERR replaced many wheels as they wore out. The ERR standard passenger streetcar wheel had been a rolled steel wheel with a diameter of 34 inches (864 mm). Rolled steel wheels were expensive compared to other types of wheels that were used by other street railways. One type of wheel that was less expensive was fabricated from cast iron. Several cast iron wheels were purchased and installed on several streetcars during this period. (SRDGL, Account T13) It should be recalled that the first fourteen ERR streetcars had been originally equipped with cast iron wheels. It should also be remembered that they had been replaced with rolled steel wheels because the cast iron wore down quickly. The type of cast iron wheel that was obtained at this time, unlike the cast iron wheels used in the past, were 34 inches (864 mm) in diameter and were of heavier construction. The new wheels contained nine spokes whereas the original wheels had possessed only six. (ERR Drawing of Cast Iron Wheels, 1915) Rapid wear was still a problem with the new cast iron wheels. In consultation with the Toronto and York Radial Railway (T&YRR) of Toronto, Ontario, the ERR became aware of a method whereby the use of cast iron wheels could be prolonged. (T&YRR Drawings of Steel-Tired Wheels, December 1913)

When the flange of a cast iron wheel became too thin, the wheel was turned on a wheel lathe until the circumference was reduced to a specific diameter. A commercially fabricated flanged steel tire, which was heated in the shop, was then placed around the cast iron wheel. As the tire cooled, it shrank onto the cast iron centre, gripping it tightly. This type of steel-tired wheel was installed on several ERR passenger streetcars beginning in 1916. (ERR Drawing of Steel-Tired Wheel, 1915) The steel tire prolonged the usefulness of the cast iron wheel.

The installation of cast iron and steel-tired wheels on ERR rolling stock ceased during 1925 when the ERR re-adopted the rolled steel wheel as its standard streetcar wheel. (SRDAR, 1925, p. 2 and ERR Drawings of Standard Streetcar Wheel, 1928)

Between 1915 and 1924 the roof mounted signs on streetcars equipped with them were removed. The marker lamps were left in place. (Glenbow Archives Photographs) Edmonton had abandoned its system of named streets in favor of numbered streets. In addition, the ERR had begun to refer to routes by dash mounted colored signs and lamps only, dispensing with the use of displayed destination names. (Canadian Railway and Marine World, August 1919, p. 448, and Current Flashes, July 15, 1921, pp. 1-2) The illuminated signs, therefore, were no longer required.

After the end of the First World War, the ERR began to replace the arc headlamps then in use with dash mounted incandescent headlights of a similar design to the incandescent headlights used between 1910 and 1912. The new incandescent headlights were designated "type Z" and were manufactured by the Crouse-Hinds Company. (SRDGL, Account T13, Photographs in City of Edmonton Archives and Artifacts in Author's Collection) The arc headlights were removed because their extremely bright light had tended to dazzle motorists, preventing them from seeing the road and any obstacles in their way. (Letter to the City Commissioners from ERR Superintendent W. J. Cunningham, August 5, 1926)

This was the fourth time that the ERR had changed the type of headlights in use on streetcars since 1908. The change from arc headlights to incandescent headlights was brought about by the increase in motor vehicle traffic following the end of the First World War. The apparatus used by the ERR was frequently altered by external technologies. Other examples of this phenomenon will be discussed in subsequent sections.

By 1919, the ERR had begun to alter the interior passenger signal systems found in streetcars so that either an electric bell or a hammer gong was located in the front vestibule. With the cessation of two man operation, the bells in the rear vestibules were no longer required, so they were removed. (Canadian Railway and Marine World, April 1919, p. 204)

It appears that the ERR dispensed with the use of automotoneers during this period since ledger entries for the acquisition of automotoneer parts cease by the end of the First World War. (SRDGL, Account T13) It is probable that the automotoneers were discontinued because of their apparent continual need for parts and repair.

Equipment Disposal, 1917

On June 13, a broken trolley wire fell onto the roof of streetcar Number 22 as it was travelling south along 109th Street. The wire touched the smoke stack of the heater which created a short circuit. The resulting sparks and heat started a fire which consumed the entire body of Number 22. The fire was extinguished before it destroyed the frame and the trucks. Although the body of the streetcar had been destroyed, both the frame and the trucks were pulled back to the car barns where they were retained for the possible rebuilding of the streetcar. (Edmonton Journal, June 14, 1917, p. 12)

It has been mentioned previously that there was a surplus of passenger streetcars on the ERR as early as 1914. The ridership on the ERR had not improved substantially by 1917; and with the acute financial situation, the City decided to sell some of their surplus streetcars. It has also been mentioned that the big Preston streetcars were selected for sale since they could not be fitted with double-width front doors without extensive vestibule reconstruction. In July, the City sold streetcars 80 and 81 to the Oshawa Street Railway Company through equipment broker D. M. Campbell, formerly the General Manager of the Preston Car and Coach Company, now defunct. The two streetcars were sold complete with motors and air brake equipment. (SRDGL, Account C6A, and Edmonton Bulletin, July 6, 1917, p. 1)

Equipment Disposal, 1918

The City continued to dispose of surplus ERR rolling stock. Two additional big Preston streetcars, 50 and 58, were sold. They were purchased through D. M. Campbell by the T&YRR. (SRDGL, Account C6B) The destruction of several T&YRR streetcars in a car barn fire earlier in the year prompted that street railway to purchase the Edmonton streetcars. (Canadian Railway and Marine World, September 1918, p. 404)

The differential dump car S-5 was also sold. The dump car had been used primarily to haul bricks to the site of the Highlands School. The unit was not used much after the completion of the school building. In addition, most freight hauling assignments could be undertaken by the versatile motorized flat car. The ERR, therefore, deemed S-5 surplus and the unit was sold to D. M. Campbell. (SRDGL, Account C6G) The ultimate disposition of the dump car is not known.

At some point during 1918, streetcar Number 2 was involved in a mishap with a train at a level crossing. The damage to Number 2 was extensive enough so that the ERR did not consider it economical to repair the unit as a passenger vehicle. The ERR did use the frame and trucks from Number 2 when they fabricated a new sweeper car. (SRDGL, Account C6C)

Freight and Service Equipment, 1918

The previous section mentioned that the frame and the trucks of streetcar Number 2 were used as part of a new sweeper car. This unit, which was completed by November, was a single end sweeper. The body frame, without the vestibules, supported a wooden deck and a cab which was placed in the centre of the frame. The cab contained a heater in addition to the controllers and the air brake valve. A broom assembly taken from the McGuire-Cummings sweeper was placed at one end of the frame. A truss assembly along the left-hand side of the cab near the roof supported the end of the broom assembly. A small wooden box placed in front of the cab enclosed the broom motor and protected it from the elements. (SRDMR, June-December 1918, and Plate 29) Plate 29 (City of Edmonton Archives) shows the ERR built sweeper sometime during the early 1930's. The truss rod leading from the cab roof should be noted. The small vehicle behind the sweeper is former passenger car Number 7. Its condition will be described in a subsequent section.

The combination baggage/sweeper car that was in use from 1909 was converted to single end operation during 1918 since one of its broom assemblies was installed on the sweeper described above. With most ERR lines equipped for single end streetcars, several double end sweepers were no longer required. In addition, by converting the baggage/sweeper car to single end operation, the ERR was able to equip an additional sweeper at a very low cost. The additional sweeper enabled the ERR to improve the rapidity with which snow was removed from their lines.

During this period, line car L-1 underwent some modification. The roof-mounted platform, which appeared to be too high for crews to work on the overhead wires comfortably, was removed. (See Plate 15) The platform was replaced by a wooden tower arrangement which was similar in construction and operation to the tower on the tower wagon. (See Plates 13 and 17) The new line car tower was somewhát larger than the tower on the tower wagon. In order to accommodate the larger tower on the line car deck, the cab was moved several feet (mm) towards one end of the frame. The tower was then placed on the deck behind the cab. A running board was placed along the centre of the cab roof. Current collection was accomplished by a single trolley pole which was installed on the centre of the cab roof. A Glenbow Archives photograph shows the line car in its modified form towards the end of 1918. (NC-6-5179) It is likely that the line car was operated as a single end unit from this time since the wire reels could be placed at only one end of the line car.

Equipment Disposal, 1919

The ERR passenger fleet was reduced by one streetcar on October 27 when streetcar Number 21, travelling east along 102nd Avenue, derailed while crossing a bridge near 132nd Street and overturned into the ravine below, destroying its body and frame. It was fortunate for the passengers that the front truck fell into the ravine before the body did. In addition, the kingpin holding the rear truck sheared as the body overturned, so the rear truck remained on the track. No passengers were killed in this mishap but the impact of the crash not only demolished the sides of the streetcar, it bent both needle beams as well. (CECR No. 227, October 27, 1919, and Photographs of Mishap in City of Edmonton Archives)

Passenger Equipment, 1919-1920

The destruction of Number 21 in October meant that another double end streetcar had to be assigned to the 102nd Avenue line since that track had no facilities for turning single end streetcars. That particular line had never been heavily used and had been unremunerative since it had been built. (Edmonton Official Gazette, April 9, 1914, p. 6) In an attempt to reduce the operating costs of that streetcar line, the ERR assigned streetcar Number 7 to it. It should be recalled that Number 7 had not been used for passenger service for several years because of its small size and its lack of air brakes. Number 7, however, was well suited to the 102nd Avenue line since it was practically flat and because it did not have a heavy ridership. In addition, that streetcar possessed only two motors so power consumption and, therefore, operating costs were reduced. Number 7 remained in service on the 102nd Avenue line until 1927 when it was removed from passenger service yet again. (Edmonton Journal, June 8, 1929, p. 20)

As early as 1914, the ERR management had discussed the possibilities of operating a sight-seeing car on the street railway. (Edmonton Journal, December 30, 1914, p. 1) The Calgary Municipal Railway had been operating a commercially built sight-seeing car since 1912 and it had become a popular feature in that City. (Canadian Railway and Marine World, July 1912)

In 1914, the ERR did not have the financial means to purchase a sight-seeing car. In addition, the First World War severely reduced the population in Edmonton. Plans for a sight-seeing car were, therefore, postponed until after the end of the War. A previous section mentioned the destruction of streetcar Number 22's body by fire in 1917. In 1919, the ERR began the construction of a sight-seeing car using the frame and the trucks from streetcar Number 22. (SRDGL, Account C6C) It seems probable that the ERR used the Calgary sight-seeing car as a model for a similar vehicle since there was a marked physical similarity between the two cars. (Glenbow Archives Photographs of Calgary Sight-seeing Car, and Plate 30)

The entire frame of Number 22 was used, including the vestibules. A curved wooden dash was attached to the end of the front vestibule. The floor was arranged in tiers, ascending from the front vestibule. The tiered floor was enclosed by decorated wooden sides. A staircase installed near the back of the floor enabled passengers to descend to the rear vestibule. Twenty-one wooden slat cross seats were placed on the floor which gave the vehicle a seating capacity of forty-two passengers. (Edmonton Journal, June 30, 1920, p. 6, and Plate 30) Wire netting was placed along the left-hand side of the car above the wooden sides in order to prevent passengers from sticking their heads or arms out. Unlike the Calgary unit, the ERR's sight-seeing car possessed a canvas-covered wooden arch roof, in addition to a small windshield which was placed between the front dash and the bottom of the roof. A roof mounted headlight, which was taken from one end of the combination baggage/sweeper car, illuminated the track ahead of the unit when it was dark. (City of Edmonton Archives Photograph of Combination Baggage/-Sweeper Car, and Plate 30)

The sight-seeing car, referred to as the "observation car" by ERR personnel, was completed in June 1920 and was placed in service on

July 1. (SRDAR, 1920, p. 1) The observation car was painted white above the trucks. The panels in the sides of the unit were painted gold with red trim. The only lettering consisted of the abbreviation "E.R.R." which was painted in gold on the front of the dash. (Edmonton Journal, June 30, 1920, p. 6) Plate 30 (Provincial Archives of Alberta) shows the appearance of the ERR's observation car sometime during the early 1920's. The wire netting along the left-hand side should be noted.

The observation car was used regularly during the summer months until the end of 1925. In 1926, the ERR discontinued regular observation car service for two reasons. Firstly, the revenue earned did not offset operating costs; secondly, the observation car could not stop for long periods in the central part of Edmonton to load passengers since it impeded regular streetcar service. (Edmonton Bulletin, February 16, 1926, p. 10) The observation car was used for special excursions between 1926 and 1935, at which time it was retired and stored at the Cromdale car barns. (Electric Railway Statistics, 1926-1936, and Photographs by R. J. Walker) The observation car remained extant until 1945 when it was stripped of all useable parts and destroyed by the ETS. (Photographs by R. J. Walker and E. Smith)

Equipment Disposal, 1922-1927

By the early 1920's, many residents of Edmonton no longer used a horse and carriage as their personal means of transportation. Various types of motor vehicles were used instead. In addition, the increased use of the motor truck meant that many mercantile establishments abandoned the use of horses. It should be noted that horses were costly to keep since they required daily feeding whether they were used or not; and they required heated shelter in winter. The diminished use

Plate 30. (Provincial Archives of Alberta) Observation Car

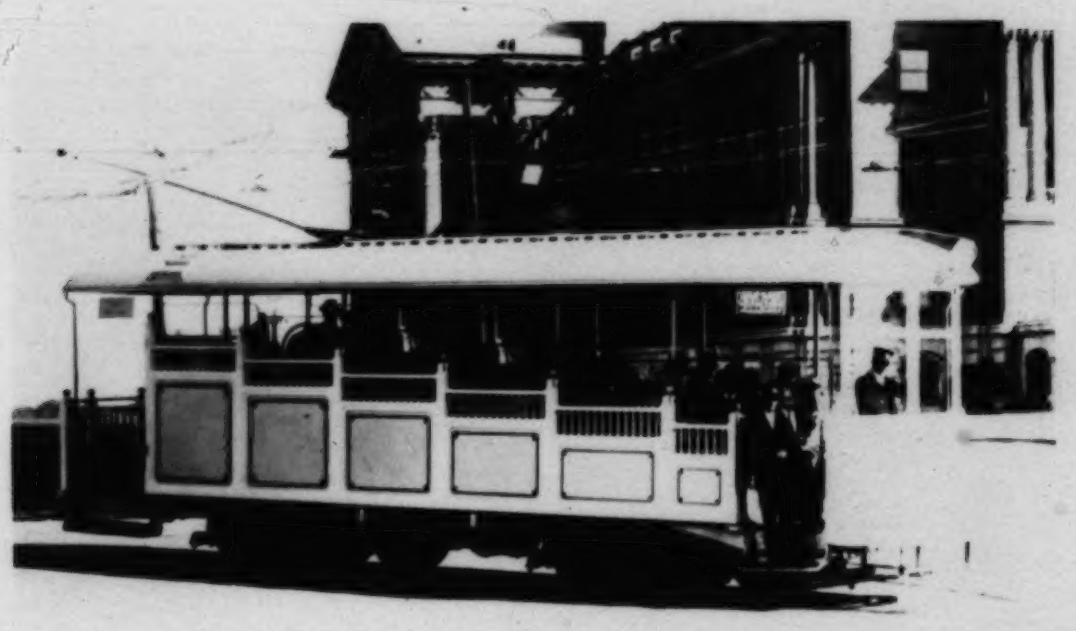


Plate 31. (Author's Collection) Streetcar Number 84

of the horse in Edmonton meant that the amount of manure deposited on the City streets was reduced. The City, as well, had begun to purchase sprinkler trucks in 1913 to replace the horse-drawn sprinkler wagons that had been in use. (Glenbow Archives Photograph NC-6-597) The sprinkler trucks were more versatile than either the older sprinkler wagons or the ERR sprinkler cars. The trucks could travel along any street whereas the sprinkler cars could not. In addition, the trucks possessed motor-driven pumps that sprayed water with as much force as the sprinkler cars did. The increased use of the automobile, coupled with the introduction of sprinkler trucks, made the ERR sprinkler cars obsolete.

At the end of the 1921 sprinkling season, the ERR retired the Preston sprinkler car. Crews removed the tank and sold it locally in April 1922. (SRDGL, Account C6) The frame was stripped of its electrical gear and was placed in storage on an outside track near the Cromdale car barns. (Glenbow Archives Photograph NC-6-11154)

Sprinkler S2 (the McGuire-Cummings unit) was retained in serviceable condition until late 1924 when its tank was removed and sold. (SRDGL, Account C6) It should be noted that the last time S2 sprinkled or flushed any streets was during October 1922. (SRDMR, October 1922-December 1924) The frame of this sprinkler was also retained for later use.

The unmotorized flat car was retired and disposed of in early 1922. (SRDMR, January-September 1922) It is probable that the flat car had not been used much following the end of the First World War because of the emergence of large capacity motor trucks.

In December 1927, streetcars 3 and 7 (both built in 1908) were retired because they were in poor condition. Superintendent Cunningham was of the opinion that it was not worth the expense to rebuild these units. (SRDMR, January 1928, Letter to Commissioner D. Mitchell from

SRD Superintendent W. J. Cunningham, April 8, 1929, and Edmonton Journal, June 8, 1929, p. 20)

Freight and Service Equipment, 1922-1929

It was described in a previous section how the Preston sprinkler was retired and stripped during 1922 and was placed in storage. In Chapter III it was mentioned that in 1922, the ERR received permission from the BRC to connect their track on 97th Avenue to a railroad spur which led to the City Power Plant. (BRC Order No. 32036, January 23, 1922) Furthermore, the ERR constructed that interchange in order to receive railroad hopper cars laden with coal cinders. The cinders were to be used as ballast on unpaved sections of ERR track. (Canadian Railway and Marine World, March 1922, p. 150) Although the hopper cars could deposit the cinders along the track, they could not distribute them evenly. A vehicle with a blade at the end as well as a blade at the side was required for this purpose. It seems probable that the combination baggage/-sweeper car was used for ballast spreading initially since it possessed a blade along one side. The unit, however, was not designed to spread ballast and it could not be used for this purpose when it was required for the dispatch of freight. Therefore, the ERR constructed a ballast spreader car using the frame of the Preston sprinkler. (Photographs in Author's Collection) The ballast spreader consisted of a large wooden blade which was mounted at one end of the frame. The blade was installed at a 45° angle facing the right-hand side. In addition, the height of the blade above the rail could be controlled by two steel cables which were attached to a winding shaft which was mounted on the wooden deck placed on the frame. Another wooden blade, placed along the right-hand side of the frame, was hinged along one end and was used to spread the ballast along the sides of the track. The free end of this blade was supported by a steel wire which was held by a jib arrangement mounted on the deck. A small wooden cab, which resembled the cab of the line car but was smaller, was placed near the end of the frame which held the blade. The cab contained the controller and the air brake valve. A smoke stack is not visible in photographs of this unit so it is unlikely that it possessed a heater. (Photographs in Author's Collection) It is probable, therefore, that the ballast spreader was not used during winter months. The ballast spreader car, which was numbered 5, was placed in operation by September 1922. (SRDMR, January 1921-December 1923)

In 1925, the frame and the trucks of sprinkler S2 were used by the ERR as part of a wrecking car. The ERR constructed a wooden body which resembled the body of the combination baggage/sweeper car and placed it on the sprinkler frame. (SRDAR, 1925, p. 2) The body, which was constructed for double end operation, held a single trolley pole (on the centre of the roof) which could be swung around when it was desired to change the direction of travel. The body was equipped with a heater in order that the unit could be operated during winter. (Photographs in Author's Collection)

The purpose of the wrecker car was to assist any other ERR rolling stock that became disabled for any reason. (SRDAR, 1925, p. 2) The wrecker car, which was numbered 6, was equipped with: lifting jacks, car replacers (tapered castings which guided a derailed wheel back onto the rail), chains, steel cable, trolley poles, journal box packing, grease and miscellaneous tools. (Letter to Commissioner D. Mitchell from SRD Superintendent W. J. Cunningham, November 15, 1926)

In 1928, the SRD refurbished and repainted all three sweepers.

(SRDAR, 1928, p. 2) It is probable that the numbers on sweepers 2 and 3 were reversed at this time.

The body, electrical equipment and the vestibules were removed from former streetcar Number 7 during 1929. A large steel tank, in addition to a wooden deck, was mounted onto the frame. The tank was probably a surplus item from the Cromdale car barns boiler replacement of 1925. (SRDAR, 1925, p. 4) A pump, which had been salvaged from one of the sprinkler cars, was also installed on the deck. Through a system of pipes, the pump pressurized the contents of the tank. Three perforated pipes were installed on the unit so that they hung over one end of the frame. The purpose of this unit was to spray a toxic liquid over the area of unpaved tracks in order to reduce weed growth. Warning lights were mounted beneath the frame to warn individuals of the hazardous spray. (See Plate 29) The "weed killer car" was unpowered and had to be pulled by some other unit of rolling stock. The hand brake was left intact, however, but the brake handle was replaced by a horizontally-mounted wheel. Electric power for the pump and the warning lights was provided by an electrical cable which was connected to the weed killer car at one end and to the towing vehicle at the other end. Plate 29 (City of Edmonton Archives) shows the weed killer car being pulled by the ERR built sweeper sometime during the early 1930's. The tank, pump, pipes and lights should all be noted.

Equipment Modifications, 1925-1930

Beginning in 1925, the ERR embarked upon a program to improve the operation of their passenger streetcars. (SRDAR, 1925, pp. 2-3) It was noted in a previous section that the ERR's plan of installing double-width front doors on their streetcars was halted by the extensive modifications required for short single end vestibules. In addition, it was mentioned that the ERR had experienced difficulty with the installation of their double tread folding steps on streetcars equipped with the double-width front doors. In order to overcome these difficulties, the ERR abandoned the use of double-width front doors. Streetcars that had been equipped with double-width front doors eventually had them replaced by single-width folding doors and the double tread folding step. (Letter to the City Commissioner from ERR Superintendent W. J. Cunningham, February 18, 1926) The interior vestibule space in streetcars with short front vestibules was extremely limited. This condition caused crowding and reduced the speed at which these streetcars could be loaded and unloaded. Two types of vestibule modification were introduced to alleviate this condition. In wooden-frame streetcars where the bulkhead was an integral part of the substructure, a wider opening was made in the bulkhead adjacent to the front door. In the big Preston streetcars which had steel frames, the bulkhead was more ornamental than functional. As each big Preston streetcar was overhauled, the front bulkhead was moved towards the rear of the streetcar by approximately 18 inches (457 mm). This distance was probably selected because the bulkhead placed in this position vertically bisected the first body window along the left-hand side. That particular window was reformed into two smaller windows on either side of the bulkhead. In addition, the new placement of the bulkhead did not reduce the seating in the body. The large opening in the right-hand side of the bulkhead made the partitioning of the first body window on that side unnecessary.

Changes to the interior lighting of the streetcars were made during this period. The older arrangement of three lines of bulbs along the ceilings was abandoned in favor of a single line of bulbs along the ceiling.

By using bulbs of higher intensity, the ERR believed that higher light levels and a more even distribution of light throughout the interior was achieved. (Letter to F. T. Fisher from the City Commissioners, December 29, 1926)

Besides adopting a standard interior lighting configuration for its passenger streetcars, the ERR standardized the placement of the Peter Smith heaters as well. In the past, some passenger streetcars had the heater installed inside the body while other streetcars had the heater in one of the vestibules. It was discovered that the placement of the heater within the car body meant that the front vestibule became extremely cold in winter. In addition, with one man operation the motorman could not tend the fire easily if the heater was located behind the front bulkhead. (CECR No. 9, February 13, 1928) The ERR placed the heater of each passenger streetcar in the front vestibule in the case of a single end car, and in one of the vestibules in double end streetcars. (Photographs in Glenbow Archives, and Photographs in Author's Collection) The duct work of the heater was extended into the rear or opposite vestibule in order to provide heat to those locations. (Letter to the City Commissioners from SRD Superintendent T. Ferrier, December 24, 1936)

A new type of warning signal was installed on most of the ERR rolling stock during 1925. In the past, pedestrians and vehicles had been warned of streetcars' maneuvers by means of foot gongs which were mounted beneath the floors of the vestibules. With increased use of the automobile, the noise of the gong was frequently obscured so the ERR investigated the possibility of using some other warning device. Several Canadian street railways had installed small air operated whistles on their streetcars in the past. These whistles could be heard above most street noises. (Letter to ERR Superintendent W. J. Cunningham from the Calgary Municipal Railway, March 25, 1925) By the end of July 1925, the ERR had decided to equip its rolling stock with air operated whistles. The whistles, which were cylindrical in shape, were manufactured by the Canadian Westinghouse Company. (Letter from Canadian Westinghouse Co. to ERR Superintendent W. J. Cunningham, July 23, 1925)

The installation of the whistles was a fairly simple operation. In the vestibule, a short length of pipe was connected to the air pipe which led to the air brake valve. The short pipe was attached to a small spring valve which was located between the controller and the brake valve. Another pipe was connected to the valve. This pipe, on most passenger streetcars, extended down through the vestibule floor where the whistle was attached to it. (Author's Observations, and Photographs in the Author's Collection) On most freight and service rolling stock, the whistle was placed adjacent to one of the forward-facing cab windows, well above floor level. (Photographs in Author's Collection) By early 1926, most streetcars had the air whistles installed. (Letter to ERR Superintendent W. J. Cunningham from Superintendent of Canadian National Railways, March 17, 1926)

In 1926, the ERR also began the final conversion of the passenger fleet to the double-tread folding step which was introduced some years earlier. At this time, streetcars 32 through 46 underwent the additional conversion from double-width doors to single-width folding doors. (Letter to the City Commissioners from ERR Superintendent W. J. Cunningham, February 18, 1926) A new paint scheme was adopted by the ERR in 1926.

On June 1, streetcar Number 77 appeared in service in a red, ivory (cream) and black livery. (Edmonton Bulletin, June 1, 1926, p. 9) The new color scheme was considered by many citizens to be more esthetically pleasing than the former brown and yellow scheme. (Edmonton Journal, June 2, 1926, p. 13) In addition, the paints used in the new color scheme were modern enamels which did not require a protective coating of varnish. (Letter to the ERR from Pratt & Lambert Inc., September 4, 1930) The red, which was applied to the exterior sheathing below the belt rail, resembled Pantone ink shade 221C. The ivory, which resembled Pantone ink shade 486C, was applied between the belt rail and the roof. (Color Fragments in Author's Collection, and Pantone System Matching Book, 1980) Both the roofs and the trucks were painted black. (Edmonton Bulletin, June 1, 1926, p. 9) The name "Edmonton Radial Railway" was dropped and no lettering was placed on the streetcar. The car number in gold or yellow was placed near each end of the body sheathing on each side of the streetcar, however. The number in black was also placed on the letterboard at each end of the streetcar, centred above the middle window of the vestibule. (Glenbow Archives Photograph ND-3-4661, and Photographs in the Provincial Archives of Alberta) The SRD was able to repaint a maximum of eighteen streetcars a year during this time. Nine streetcars had already been repainted in the old color scheme in 1926 when the new paint scheme was introduced. Only nine additional streetcars could be repainted in the new colors in 1926. (Edmonton Journal, June 2, 1926, p. 13)

Several external modifications were made to the streetcars when they entered the shops for repainting. The roof mounted marker lamps were removed and were replaced by two clear lenses which were installed on the letterboard directly above the middle vestibule windows at each end of the streetcar. The lenses were spaced approximately 15 inches (381 mm) apart. This spacing enabled the two lenses to be distinguished from a distance, as well as providing space for the car number between them. The lenses were held in place by portions of the old marker lamps which had been dismantled. (Artifacts in the Author's Collection) Holes drilled through the letterboards directly behind the lenses enabled light within the vestibule to reach the lenses. Locally fabricated steel brackets which held several colored glass discs were placed inside the vestibules directly in front of each hole which led to a lens. The discs could be privoted individually in line with the hole, thus changing the color of the light reaching the lens. In this manner, the streetcar could display a colored route designation. A single bulb placed in the vestibule in front of each hole provided light for each lens. (Author's Observations, and Artifacts in Author's Collection) The marker lamps were probably removed because they were prone to damage and tended to leak when it rained or snowed.

A small sheet metal awning was placed over the centre window of each forward-travelling vestibule during this period. (Canadian Railway and Marine World, August 1927, p. 723) The purpose of the awning was to keep direct sunlight out of the motorman's eyes since most of the SRD's passenger streetcars did not possess shades for the front vestibule windows. The awning and the letterboard lenses can be observed in Plate 25. It should be noted that no number is visible on the letterboard between the lenses. This is because the streetcar shown was painted in a later version of the red and ivory paint scheme which omitted the letterboard number.

The SRD mounted rectangular wooden boxes on the dash of each vestibule immediately below the belt rail. These boxes, which were placed adjacent to the doors, were designed to hold painted sheet metal signs which displayed the color or colors of the particular route on which that streetcar was travelling. The sheet metal signs, which were 12 inches (305 mm) wide by 23 inches (584 mm) long, were supposed to be recognizable from a distance of three blocks. (Letter to the City Commissioners from SRD Acting Superintendent A. Robertson, June 17, 1927, and Artifacts in Author's Collection) At night, the letterboard lenses indicated the color or colors of the route.

A small roller sign was also installed in one of the upper sashes in each vestibule. These roller signs, which resembled the illuminated signs that were installed on the big Preston streetcars, contained three incandescent bulbs for illumination. The signs displayed the location of the terminus of the route. The roller signs were considered to be a supplement to the colored signs and lamps, hence their small size. (Letter to the City Commissioners from SRD Acting Superintendent A. Robertson, June 17, 1927) In addition to these signs and lamps, the SRD placed two metal brackets on each side of each passenger streetcar's body immediately below the belt rail. These brackets, which were spaced several feet (mm) apart, were designed to hold narrow boards on which were affixed advertising messages. (Letter to the City Commissioners from SRD Superintendent W. J. Cunningham, January 19, 1927) The metal signs, roller signs and the brackets can be seen in Plate 25.

During this period, some streetcars were equipped with a trolley rope guide which was designed to prevent the trolley rope from rubbing and snagging on the streetcar's letterboard. The guides were fabricated from steel round stock and were bolted to the letterboard. Small hooks formed at each end prevented the trolley rope from slipping off the guide. (Glenbow Archives Photograph ND-3-4661) The rope guides do not appear to have made a significant difference in operation since only a few streetcars appear to have been fitted with them. (Photograph in

Author's Collection)

Complaints about the type of headlight in use were received by the SRD during 1926. It had been observed by several citizens that the light produced by these incandescent headlights was too dim in areas with little or no street lighting. A concern was expressed that if the light intensity were not improved, a serious accident could occur as the result of the motorman being unable to see a hazard along the track. (Letter to the SRD Superintendent W. J. Cunningham from the City Commissioners, August 3, 1926) In order to avoid the possibility of a fatal accident, the ERR subsequently equipped several passenger and service streetcars with an additional headlight which was mounted on the dash or cab directly above the normal headlight. The new supplemental headlight, which was smaller in diameter than the regular headlight, contained a prismatic reflector which tended to concentrate the light beam to a narrow path in front of the streetcar. In addition, the higher placement of the supplemental headlight meant that the track would be illuminated further ahead than it had been with the standard headlight. (Letter to SRD Superintendent W. J. Cunningham from Canadian Ohio Brass Co., January 9, 1928)

The speed of loading and unloading the big Preston streetcars remained slow in spite of the increase in space of the front vestibules. Superintendent Cunningham, wishing to overcome this problem, planned to install a treadle operated door in the rear vestibule of a big Preston streetcar as an experiment in late 1926. (Letter to Railway & Power Engineering Corp. from SRD Superintendent W. J. Cunningham, December 22, 1926) The treadle operated rear door was intended to allow passengers to leave by the rear vestibule, thus reducing crowding in the front vestibule.

The treadle assembly, which was manufactured by the National Pneumatic Company and purchased from the Railway and Power Engineering Corporation of Toronto, consisted of a steel plate (the treadle) which was 20 inches by 25 inches (508 mm X 636 mm) in size. The treadle was hinged along one edge and rested on top of spring loaded electrical switch, the contacts of which were normally open. A small pipe was installed in the front vestibule which was connected to the air pipe leading from the brake valve to the brake cylinder. A small rotary valve, which was similar in operation to the air brake valve, was attached to the end of the pipe. This valve, referred to as the "conductors control", was connected to another pipe which led to a magnet valve which was located in a box placed above the right-hand doorway in the rear vestibule. The magnet valve, in turn, was connected to an air cylinder which was located next to the magnet valve. (Letter to SRD Superintendent W. J. Cunningham from Railway & Power Engineering Corp., April 11, 1927, p. 3) The piston in the air cylinder was connected to a lever which could open and close a folding door which was installed beneath the cylinder and the magnet valve.

The operation of the treadle exit was simple and safe. When the air brakes were applied, compressed air reached the pipe leading to the conductors control. When the motorman moved the handle on the conductors control to the right, the compressed air was allowed to reach the magnet valve. If a passenger stepped on the treadle at this time, the switch beneath the treadle would close a circuit leading to the magnet valve. The electromagnet on the valve, which acted as a solenoid, opened the valve, enabling air to reach the cylinder. The air pushed the piston in the cylinder and, in turn, opened the door through the levers, allowing the passenger to leave. When the passenger stepped off the treadle, the circuit to the magnet valve was opened and the air supply to the cylinder was cut off. A spring inside the cylinder forced the piston back to its original position. A small hole in the cylinder prevented the air from escaping too quickly, thus preventing the alighting passenger from being injured by the doors. In addition, the edges of the doors contained hollow rubber strips which were intended to prevent a passenger's arm or hand from being crushed should the doors close before they were clear. Safety features were also incorporated into the design of the treadle unit. While the doors were open, air travelled along a pipe which led from the cylinder to a double check valve which prevented both the air in the brake cylinder and the air in the door mechanism from being released. This safety feature eliminated the possibility of a motorman moving the streetcar before the rear door was closed. In addition, indicator lights located in the front vestibule informed the motorman whether the rear door was open or closed. (Letter to SRD Superintendent W. J. Cunningham from Railway & Power Engineering Corp., April 11, 1927, pp. 3-4)

The installation of the treadle in a big Preston streetcar was not a simple operation. The treadle and the switch had to extend below the floor level. No obstructions, therefore, could be tolerated beneath the location of the treadle. One of the steel vestibule knees happened to lie directly beneath the proposed location of the treadle. SRD crews had to relocate the knee several inches (mm) towards the centre of the vestibule before the treadle could be installed. Once this was done, a portion of the vestibule floor was removed. A two tread metal step assembly was fabricated which incorporated the treadle as the upper tread. This assembly was bolted to the floor and to the knee. A single-width folding door was installed between the treads of the assembly.

The door and treadle were placed next to the rear bulkhead for extra support. (SRD Drawing of Rear Exit for Treadle Steps, December 1926)

Only streetcar Number 74 was fitted with a treadle assembly. (Cunningham, 1927, p. 2) The operation of the treadle mechanism was observed for several months and was deemed successful. Although the treadle functioned satisfactorily, most passengers were reluctant to use it, preferring to exit by the front door. (Cunningham, 1929, p. 2) No further streetcars were fitted with the rear treadle exit and the unit on Number 74 was eventually removed. The difficulty and expense of installing the treadle assembly combined with the public's reluctance to use that exit probably convinced the SRD to abandon further plans for installing the treadle exit on the big Preston streetcars.

Several streetcars underwent extensive rebuilding during this period. The vestibules on some of the older wooden frame units had begun to sag badly. In addition, the side sills on some of these units were checked or were otherwise weak. These streetcars had to undergo extensive rebuilding or they would have been unsafe to operate. (SRDAR, 1925, p. 2; 1926, p. 1 & p. 4) In an attempt to prevent further problems with the weakened wooden sills, a number of streetcars had steel channel beams installed above the side sills while they were being overhauled. The beams, which were bolted to the sills and their metal reinforcing strips, extended from one end of the frame to the other and eliminated the need for trusses on these streetcars. (Author's Inspections of Streetcar Number 13 and the Frame of Streetcar Number 24) In order to install the channel beams, the exterior sheathing had to be removed. In addition, several window posts and some of the cross-bracing had to be relocated. Photographic evidence indicates that nine streetcars were repaired in this fashion, Numbers: 8, 9, 11, 13, 15, 17, 19, 24 and 27. (Photographs in Author's Collection)

Towards the end of this period, Superintendent Cunningham began to express concern to the City Commissioners about the condition of the trucks, motors, gears and axles of the streetcars in service. In the 1926 Street Railway Department Annual Report, Cunningham stated, "The car trucks need continual attention but are kept in repair by welding" (p. 2). Cunningham investigated the possibility of replacing some of the trucks in bad condition with new trucks. In spite of several offers from truck manufacturers, Cunningham believed that the expense was not justified since most of the streetcars were becoming obsolete and would likely be retired in a few years. (Letter to the Canadian Car and Foundry Co. from SRD Superintendent W. J. Cunningham, February 11, 1927, March 7, 1930 and SRDAR, 1928, p. 2)

The SRD did, however, attempt to make some improvements to the motive power of the streetcars in service during this period. In 1925, several sets of spur gears were replaced by helical gears of the same size and ratio as the spur gears. (Letter to SRD Superintendent W. J. Cunningham from Canadian Westinghouse Co., February 20, 1925, and Letter from Canadian General Electric Co., April 15, 1925)

A helical gear is similar in appearance to a spur gear except that the teeth of a helical gear are cut so that they conform to the layout of a helix. The teeth, therefore, slant diagonally across the face of the gear. (Repp & McCarthy, 1979, p. 354) The main advantage of helical gears over spur gears are: the teeth of helical gears slide across each other rather than striking each other as they do in spur gears; helical gears produce less noise in operation; the helical layout of the teeth enable several teeth to be engaged at a time, thus providing greater gear strength. The major disadvantage of helical gears is that the increased contact area of the teeth produce more friction, so heat dissipation and lubrication can be problems. (Repp & McCarthy, p. 354) In addition, helical gears tend to be more expensive than spur gears because of their construction.

The helical gears supplied to the SRD were classified as "Grade M" solid gears. (Letter to SRD Superintendent W. J. Cunningham from General Electric Co., May 14, 1930) The grade "M" referred to the type of steel used in the gear which was a hardened and tempered medium carbon steel. The gears were fabricated from a single block of steel. Solid gears, unlike split gears, were better suited for heat dissipation. (General Electric Co. Catalog No. 20, 1920-1921, p. 697)

The operation of the helical gears appears to have been successful since the SRD continued to replace worn spur gears with helical gears throughout the 1920's. (SRDAR, 1928, p. 3)

It was mentioned in an earlier section that streetcar Number 3 had been retired at the end of 1927. By 1929, the ridership on the street railway had increased by such an extent that extra streetcars were required quickly. Superintendent Cunningham believed that it was possible to rebuild Number 3 and to place it back in service. It is, therefore, apparent that Number 3 was not scrapped after its retirement. During the rebuilding of that streetcar, it was changed from double end to single end operation. (Letter to Commissioner D. Mitchell from SRD Superintendent W. J. Cunningham, April 8, 1929) It seems likely that the vestibule selected to be at the rear of the unit was lengthened in order that it could be used as a smoking compartment. It should be recalled that an SRD listing of passenger equipment from the early 1920's listed streetcars 1, 3, 4, 5 and 6 as all having the same overall length as the length stated in the builder's specifications of 1908. (SRD Table of Weights and Levers, circa 1920) The rear vestibule was lengthened approximately 16 inches (406 mm). (Author's Measurement of Streetcar Number 1, and Photographs by R. J. Walker) It should also be noted that streetcar Number 1 was also rebuilt during 1929. (Edmonton Journal, June 8, 1929, p. 20) It is probable that Numbers 1 and 3 both received the same rebuilding modifications since both streetcars appear to be, on the exteriors, identical in subsequent photographs. Numbers 4, 5 and 6 also received lengthened rear vestibules before the 1930's. (Photographs in the Author's Collection, and Photographs by R. J. Walker)

A new type of motor and controller were installed on one streetcar in 1929. When the SRD had decided to resurrect Number 3, they had to obtain new motors and control equipment since the apparatus originally in place on that streetcar had been removed and used elsewhere. (Letter to Commissioners D. Mitchell from SRD Superintendent W. J. Cunningham, April 8, 1929) By this time, the GE-80A motor and the K-6 controller were considered obsolete. (Letter to SRD Superintendent W. J. Cunningham from Canadian General Electric Co., February 3, 1927) In order to observe directly any improvements made in the design and efficiency of motors and control equipment, the SRD obtained quotes on modern equipment. The bid of the Canadian General Electric Company was the lowest so the equipment was obtained from that firm. (Letter to Commissioner D. Mitchell from SRD Superintendent W. J. Cunningham, April 8, 1929)

The equipment consisted of four GE-247A-1 motors and a single K-35 controller. (Canadian General Electric Co. Specifications of Equipment, October 25, 1929) The GE-247A motor was much smaller in size than the GE-80A, although they had the same power rating. Smaller gears had to be used with the 247A motor because of its smaller size.

The normal gear ratio for a GE-247A motor was 58 to 15, the larger number of teeth being found on the axle gear. (General Electric Co. Drawing of GE-247A Motor, October 1926) The K-35 controller, which was identical in external appearance to a K-6 controller, possessed a greater number of fingers than the K-6 and possessed a different power shaft arrangement which enabled it to have fewer notches. The greater number of fingers, in addition to a more efficient internal design, meant that the K-35 controller could provide faster and smoother acceleration with fewer notches than the K-6 controller. The K-35 controller, as well, had provision for the installation of an automatic line breaker and other safety equipment. (General Electric Co. Schematic Drawing and Specifications of K-35-HH Controller, May 1925, and Thompson, 1940, pp. 158-159)

It is probable that the SRD did not desire to install this equipment on Number 3, which was one of the SRD's oldest streetcars. The new equipment was installed on big Preston streetcar Number 56. (Letter to SRD from Canadian General Electric Co., June 3, 1930) It is most probable that the GE-80A motors and the K-6 controller that had been on Number 56 were removed and were installed on streetcar Number 3.

Passenger Equipment, 1930

As early as 1928, Superintendent Cunningham predicted the need for additional passenger rolling stock. "With the increase in traffic it will be necessary to consider the question of obtaining additional rolling stock next year" (SRDAR, 1928, p. 2). It should be recalled from the previous section that the SRD resurrected Number 3 during 1929 because of an acute shortage of passenger equipment. The ridership on the street railway continued to increase and in March 1930, Superintendent Cunningham asked the City Council to authorize the purchase of six new streetcars which would alleviate the rolling stock shortage. (Edmonton Journal, March 10, 1930, p. 9) The City Council's decision on this matter was not forthcoming since the Council wished to receive estimates of the total cost. (Canadian Railway and Marine World, March 1930, p. 165) The SRD advertised for bids for the new streetcars.

A particularly interesting and ironic offer was received by Cunningham in April. The equipment broker D. M. Campbell offered to sell the SRD streetcars Numbers 80 and 81 which had been sold to the Oshawa Street Railway in 1917. (Letter to SRD Superintendent W. J. Cunningham from D. M. Campbell, April 14, 1930) Campbell was able to offer the units for sale because the Oshawa Street Railway had recently been taken over by the Canadian National Railways and that Company did not wish to operate that type of streetcar on its lines. (Letter to SRD Superintendent W. J. Cunningham from D. M. Campbell, April 29, 1930) After some consideration, Cunningham decided against the purchase of any used rolling stock. (Letter to D. M. Campbell from SRD Superintendent W. J. Cunningham, July 28, 1930) The May 7 City Council meeting authorized the purchase of new streetcars by the SRD based upon the estimates supplied to them by the City Commissioners. (Canadian Railway and Marine World, March 1930, p. 165)

On May 9, Cunningham submitted a summary of the bids received to the City Commissioners for their final selection and approval. Bids had been received from: the Ottawa Car Manufacturing Company (formerly the Ottawa Car Company), the National Steel Car Corporation of Montreal, and the Canadian Car and Foundry Company. Bids for the motor and air brake equipment were received from both the Canadian

General Electric and Canadian Westinghouse Companies. The lowest bid for the streetcars was received from the Ottawa Car Manufacturing Company. The cost per unit, however, was greater than the capital estimates approved by Council. Cunningham, therefore, recommended that only five streetcars be ordered. Cunningham also recommended that the motor and the air brake equipment be purchased from the Canadian General Electric Company, which was the lowest bidder. (Letter to the City Commissioners from SRD Superintendent W. J. Cunningham, May 9, 1930)

The City Commissioners concurred with Cunningham's recommendations and an agreement was finalized with the Ottawa Car Manufacturing Company on June 30, 1930. The contract stipulated, however, that the air compressors were to be supplied by the Canadian Westinghouse Company. (Ottawa Car Manufacturing Co. Contract for Streetcars, June 30, 1930)

The general specifications for these streetcars, provided by the SRD when the bids were solicited, stated that each streetcar was to have double-width folding doors in the front vestibule and a treadle operated exit door at the centre of the body on the right-hand side. In addition, the electrical equipment was to include a pneumatically operated line breaker, helical gears, and air operated safety control which would stop the streetcar should the motorman lose control for any reason. (SRD General Specifications for Six Single-End Streetcars, March 1930)

The specifications prepared by the Ottawa Car Manufacturing Company embodied all of the general specifications as well as some improvements. With the exception of the roofs and the interiors, metal was used for the entire construction of these streetcars. Open hearth steel "Z" beams were used for the intermediate sills while angle shapes and channels were used for the side and end sills, as well as for the window posts and the carlines. All steel members were riveted together. Separate vestibules were abandoned in this design. The front end of the frame was shaped so that it resembled the long vestibules on some of the earlier ERR double-end streetcars. The rear portion of the frame was shaped so that each side angled in towards the centre of the frame. This design reduced body overhang when the streetcar travelled around curves. (Ottawa Car Manufacturing Co. Specifications of Streetcars, May 1930, pp. 3-5) Body overhang was an extreme hazard to motor vehicles that happened to be travelling next to a streetcar as it made a turn.

The older style of bunter was superseded by a 7 inch (178 mm) wide rolled steel section which was called an "anticlimber". An anticlimber resembled an ordinary bunter except that an anticlimber bunter possessed several horizontal ridges of steel along its face. The purpose of the ridges were to prevent serious damage from occurring to the streetcar's vestibules should it be rammed by another streetcar. In the past if such an accident occurred, one of the colliding streetcars slid up on the bunter of the other streetcar. The result was considerable damage to the vestibule that was struck by the streetcar. This action not only destroyed the vestibule but also endangered the safety and the lives of any people in the vestibule. If both streetcars possessed anticlimbers, however, neither streetcar could slide above the other. Vestibule damage as well as danger to individuals would be minimized. Draw bar anchors were also placed at both ends of the frame. A portable draw bar was hung underneath the left-hand side of the body. It could be attached to one of the anchors if needed. (Ottawa Car Manufacturing Co. Specifications, p. 8) The absence of a fixed draw bar eliminated a possible hazard to individuals who fell in front of the streetcar. The builder also furnished a steel version of the HB lifeguard on the front of each streetcar. (Ottawa Car Manufacturing Co. Specifications, p. 10)

The window sashes were fabricated of brass. The lower part of the sash was designed to be raised a short distance with the exception of the sashes near the ends of the streetcar. Sash pockets were not required for the sashes that raised. The windows at the rear of the streetcar were stationary except for the centre window at the rear which could be dropped into a special sash pocket. The front centre window as well as the front right-hand window were also stationary but the window to the left of the motorman could also be dropped into a sash pocket. The front centre window was equipped with a single blade hand-operated windshield wiper. (Ottawa Car Manufacturing Co. Specifications, p. 8) It is important to note that these streetcars were the first vehicles on the ERR to possess such equipment. A set of small wire netting window guards were supplied with each streetcar in addition to a set of storm sashes for winter use. (Ottawa Car Manufacturing Co. Specifications, pp. 5-7)

The roofs of these streetcars were composed of white ash supports which were sheathed with poplar or basswood strips. Four ventilation ducts which were manufactured by the Nichols-Lintern Supply Company were installed along each side of the roof. The exterior surface of the roof was covered with Number 10 canvas duck and a waterproof coating. A running board as well as a trolley board, trolley base, trolley pole and a trolley rope guide were installed on the roof. (Ottawa Car Manufacturing Co. Specifications, pp. 5-7)

The interior flooring consisted of 7/8 inch (22.5 mm) thick white pine tongue and groove boards which were laid transversely. Narrow maple strips were then nailed longitudinally along the aisle areas. On either side of the strips the builder nailed 5/8 inch (16 mm) thick maple boards. These boards were aligned longitudinally. When complete, the flooring was painted with a light stone grey floor paint. The use of maple (a hard wood) for the floor meant that the floor boards would not wear as quickly as the floors in the older streetcars which were laid with pine boards (a soft wood). The flooring extended evenly from one end of the interior to the other. (See Plate 32)

The interiors were finished in clear birch between the belt rail and the ceiling. The birch was stained to resemble cherry. The wainscoating and the ceiling were composed of Agasote which was a manufactured material composed of wood fibres. Agasote was similar to masonite. The Agasote was held in place by stained birch moldings which were attached to the posts by screws. Agasote was used because of its recognized qualities as a heat insulator, a necessary feature for Edmonton. (Ottawa Car Manufacturing Co. Specifications, p. 8) Heating was provided by a Peter Smith heater in addition to ten supplemental underseat electric heaters. The interior lighting consisted of five 60 W incandescent bulbs, arranged in series, which were each enclosed in a domed glass fixture. In addition, two smaller bulbs were located near the front steps. It should be noted that flexible braided wire was used on these streetcars in place of the older solid copper wire. The wires, furthermore, were enclosed in galvanized steel conduits. The wiring was done in accordance with Federal electrical codes of that time. (Ottawa Car Manufacturing Co. Specifications, pp. 10-12)

The interior did not contain substantial bulkheads since they were not required. The movement of passengers through the interior was not impeded. The small bulkheads allowed for better heat circulation as well. The seating capacity of these streetcars was 51. A total of 17 leather upholstered cross seats were arranged along the sides of the interior in addition to two longitudinal seats placed near the front. The cross seats could seat two passengers apiece while the longitudinal seats could each accommodate three passengers. A leather covered semi-circular seat was also placed in the rear vestibule. Several stanchions were placed in the interiors. One set of stanchions guided passengers past the fare box when they entered by the right-hand front door. Stanchions were also placed around the motorman's position. These stanchions supported a canvas curtain as well as a small swing seat that could be used by the motorman. Horizontal stanchions were also placed above the semi-circular seat and above the longitudinal seats. The stanchions consisted of hard-drawn aluminum tubing. Stanchions that extended from the floor to the ceiling were reinforced with ash dowelling. (Ottawa Car Manufacturing Co. Specifications, p. 9, and Drawing T-84) It should be realized that these streetcars were the first SRD vehicles that used aluminum in part of their construction.

The interior signaling system consisted of a buzzer that operated on trolley voltage that was reduced by a resistor grid. Twenty-five push button switches, connected in parallel, enabled the passengers to operate the buzzer. The switches were mounted on the side posts along the interior as well as on the bulkheads. (See Plate 32)

Two fixed steel steps were placed in a well in front of the centre door, while a single step was placed in a well in front of the front doors. The centre doors covered the centre steps in order to prevent individuals from attempting to board there. The front doors were connected to a single-tread folding step. The treads were fabricated of steel bar stock so that it resembled a "honeycomb" pattern. The holes through the treads prevented the accumulation of snow and ice. The doors, which folded, were fabricated of cherry and were arranged to open and close by a system of air cylinders and levers. The centre doors were operated by a treadle mechanism which was similar in design to the treadle mechanism described in a previous section. (Ottawa Car Manufacturing Co. Specifications, pp. 7-9) Each streetcar was equipped with a switch iron holder, a switch iron and a guide hole through the floor which enabled the motorman to throw a switch without having to leave the streetcar. (Ottawa Car Manufacturing Co. Specifications, p. 11) This was a feature that was not present on earlier SRD rolling stock. Unless the motorman could stop his streetcar precisely above the switch tongue, he would have to leave the streetcar in order to be able to throw the switch. (See also Chapter III)

The exteriors of these streetcars were finished with 3/32 inch (2.5 mm) thick sheet steel panels which were riveted to the frame and the posts. The belt rails were formed of the same sheet steel and were arc welded to the window posts in order to prevent water from entering the interior. The sheathing on the ends was of the same material but the panels were secured to the posts by screws. In the event of a mishap, it would be easier for the repair crews to remove these panels since they were not riveted. In most collisions, the ends of the streetcar were most likely to sustain damage. (Ottawa Car Manufacturing Co. Specifications, pp. 5-6)

Illuminated roller signs were installed over the centre window of each vestibule, in addition to a non-illuminated roller sign which was placed above the first right-hand body window. The front roller sign was a double unit which displayed both route colors and termini locations. The rear roller sign displayed route colors only while the side roller sign displayed termini locations. It should be noted that the side roller sign received some illumination from the interior of the streetcar. (Ottawa Car Manufacturing Co. Specifications, pp. 8-9) A single Ohio Brass Company type WCF headlight was mounted on the front dash of each streetcar. This type of headlight contained a prismatic reflector. In addition, the sides of the housing consisted of heat resistant glass for dash illumination. A Nichols-Lintern traffic light was placed on the rear dash. (Ottawa Car Manufacturing Co. Specifications, p. 13, and Ohio Brass Co. Catalog 23, 1940, p. 170) This device consisted of a metal housing which contained two incandescent bulbs and two colored lenses, one red and the other green. When the brakes were applied, a switch would be closed that turned on the lamp behind the red lens. When the controller was on, the bulb behind the green lens was turned on while the lamp behind the red lens was extinguished. In this manner, the traffic light informed a motorist whether the streetcar was stopping or was moving ahead. It is probable that this device prevented many motorists from ramming a slowing or a stopped streetcar so equipped. The rear dash also held a Number 10 Earll trolley catcher which was similar to the type of catchers used by the other SRD streetcars. (Ottawa Car Manufacturing Co. Specifications, p. 13)

The streetcars were painted in the red and ivory paint scheme described previously. There were two modifications, however. The letterboards were painted red instead of ivory. The number at the ends of the streetcar could not be placed on the letterboards because of the roller signs. The numbers, in gold, were centred on the dashes below the centre windows at each end. (See Plate 31) The streetcars were numbered 80 through 84.

Each streetcar was mounted on two Canadian Car and Foundry

F-920 trucks. These trucks were similar in basic appearance to the Brill 27-GE-1 truck but were substantially different. The wheel base of the F-920 truck was 5 feet 4 inches (1 626 mm). This longer wheel base enabled the trucks to be arranged to accommodate two motors that were hung between the axles (inside hung). Streetcars equipped with such trucks could travel faster than streetcars with outside hung motors. The old type of sleeve bearing journal box was replaced by journal boxes which contained spherical roller bearings. (Canadian Car & Foundry Co. Drawings and Specifications of Type F-920 Truck) Roller bearings were selected because Superintendent Cunningham had obtained favorable information on them from the Canadian Car and Foundry Company and the Canadian SKF Company (a bearing manufacturer). The information received indicated that roller bearings reduced starting friction which, in turn, reduced the current consumption of the motors. In addition, infrequent maintenance was required with the roller bearings, unlike the constant maintenance required by the older type of bearings and their packing. It should be noted that the use of roller bearings in street railway trucks was new and, consequently, was not widespread. (Letter to SRD Superintendent W. J. Cunningham from Canadian Car & Foundry Co., February 19, 1930, and Letter from Canadian SKF Company, March 26, 1930) The trucks were fitted with rolled steel wheels which were 26 inches (660 mm) in diameter. This wheel diameter was selected for two reasons. Firstly, a 26 inch (660 mm) diameter wheel was the type recommended for use with the CGE-247L motor which was to be installed on each axle. Secondly, the smaller diameter of these wheels meant that the streetcar's steps would be closer to the ground. This would make it easier for passengers to alight and to board the streetcar. (General Electric Co. Bulletin No. GEA-418, June 1926, and Ottawa Car Manufacturing Co. Specifications of Streetcars, May 1930, p. 7 & p. 9)

Four CGE-247L-1 motors were installed on each streetcar. (Ottawa Car Manufacturing Co. Specifications, p. 13) These motors differed from the GE-247A motor which was described in a previous section. The CGE-247L motor was manufactured in Canada and contained castings so that it could be inside hung on a truck. In addition, the form L motor contained the General Electric Company's patented constant oil level bearing in which the oil level in the bearing housing was kept at the optimum level through a system of wicks and reservoirs. (General Electric Co. Bulletin GEA-418, June 1926) Solid type M helical gears with the ratio of 58 to 15 were also installed with each motor. (Letter to SRD Superintendent W. J. Cunningham from the Canadian General Electric Co., May 14, 1930)

Each streetcar was also equipped with one K-35-HH controller which was located in the front vestibule. (Ottawa Car Manufacturing Co. Drawing of Piping Layout, 1930) The K-35-HH controller was similar in appearance to a regular K-35 controller. The HH designation signified that the controller was designed to hold a power handle which also controlled a small air valve. This air valve, called a pilot valve, controlled air flow to a pneumatic line breaker which was located beneath the controller. (General Electric Co. Drawing of Connections for K-35-HH Controllers, May 1925) The handle, which had the designation "LB-4", was supplied by Safety Car Devices Company of Wilmerding, Pennsylvania which marketed Westinghouse products. The handle was partially enclosed in a housing which was bolted to the top of the controller. The centre of the handle contained a pivot so the handle could be moved vertically. The end of the handle beyond the pivot, inside the housing, was connected to a spring-loaded valve which was normally open. The other end of the handle held a small wooden knob which the motorman gripped. In order for the controller to function, the motorman not only had to rotate the handle in a clockwise direction, but had to push down on the handle as well or the pneumatic line breaker would not close the circuit to the motors. By holding the handle down, the pilot valve permitted compressed air to reach the pneumatic line breaker. Approximately 6 pounds (27 kg) of pressure were required to keep the handle down. A foot valve, mounted on the floor, enabled the motorman to release the handle. If the handle was released at any time the controller was on and the foot valve was not depressed, the pneumatic breaker would open, cutting power to the motors. (Safety Car Devices Co. Specifications of Controller Handle with Pilot Valve, March 1928) In addition to this action, the brakes would be applied automatically.

The air brake equipment supplied with these streetcars was more complex than the air brakes of earlier SRD rolling stock. Each unit was equipped with one Westinghouse DH-25 compressor. (Ottawa Car Manufacturing Co. Contract for Streetcars, June 30, 1930, p. 1) The DH-25 compressor was selected because it had a larger motor than other trade names and models of compressors. In addition, the DH-25 compressor could displace 25 cubic feet (0.71 m^3) of air in a minute, a greater displacement than the older D-1-EG compressor. (Westinghouse Co. Specifications of DH-25 Motor Driven Air Compressor, October 1928) The basic operation of the brakes was similar to the brakes found on earlier units of rolling stock. The brakes applied to these streetcars were designed to operate faster. In addition, they were interconnected with the controller handle through an emergency valve.

A disadvantage of the older straight air brake was that it took several seconds for the brakes to be applied once the brake handle was moved to the "service" position. This delay was caused by the distance the air had to travel between the brake valve and the brake cylinder. The new system partially solved the problem by placing an air relay valve in the pipe between the brake valve and the brake cylinder. A relay valve was designed so that it admitted reservoir air to the line when it was pressurized. In this manner, the air pressure in the pipe did not drop appreciably with the distance travelled by the air. If an emergency arose and the streetcar had to stop quickly, the short lag in brake operation could prove to be fatal. With this in mind, an "emergency straight air brake system" was designed. This system incorporated a spring valve which was known as an emergency valve. An emergency valve was installed beneath the streetcar on a pipe which led from the air reservoir. Another pipe connected the valve to the brake cylinder. An additional pipe was connected between the spring diaphragm of the emergency valve and the controller pilot valve, foot valve and the brake valve. If for any reason the controller handle was released while the controller was on, or the brake handle was moved to the "emergency" position, air pressure would be diverted to the emergency valve. This air pressure would compress the diaphragm in the emergency valve which would permit reservoir pressure to travel the short distance between the reservoir and the brake cylinder. With this action, the brakes would be applied without much delay. (Harding & Ewing, 1926, p. 385)

A Westinghouse MD-28-F combination brake valve, selector valve and sanding valve was installed on streetcars 80 to 84. The brake valve, which contained an "emergency" position, also controlled the opening and the closing of the doors. A smaller valve, which was attached to the brake valve, determined whether the front doors, centre door, or both sets of doors were to be opened. When the brake handle was moved to the position beyond "service", the doors chosen by the selector would open or, in the case of the centre door, could be opened. When the motorman moved the handle to the left, the doors closed. The front doors opened and closed in this fashion through two air cylinders, one for opening, the other for closing. The centre door was operated by a treadle so the brake and selector valve controlled the air supply to the magnet valve. In an emergency brake application, the air supply pipes to the door cylinders were opened so that the air pressure in each cylinder would be balanced. The doors could then be pushed open, if required.

The brake handle was also hinged so that it could pivot downwards in any position on the brake valve. When the brake handle was pushed down, it pushed on a semi-circular casting which was also hinged. This casting was referred to as a "sanding bail". The purpose of the sanding bail was to push open a small spring-loaded valve which enabled compressed air to reach the sanders. In this manner, the motorman could apply sand to the rails without releasing his hold on the brake handle. (Safety Car Devices Co. Specifications of M-28 Type Brake Valves, April 1928) Figure 38 (after Westinghouse Drawing of Type M-28-D Brake Valve with Selector Valve and Sanding Feature) depicts, in plan view, the brake valve described above. The handle positions should be noted.

Two air operated sanders were supplied with each streetcar. These sanders were operated from the brake valve described above. These streetcars were also equipped with a staffless hand brake which was located to the left of the motorman. (Ottawa Car Manufacturing Co. Specifications of Streetcars, May 1930, pp. 9-10)

Air operated warning devices were given prominence on streetcars 80 through 84. In addition to a foot gong located beneath the motorman's

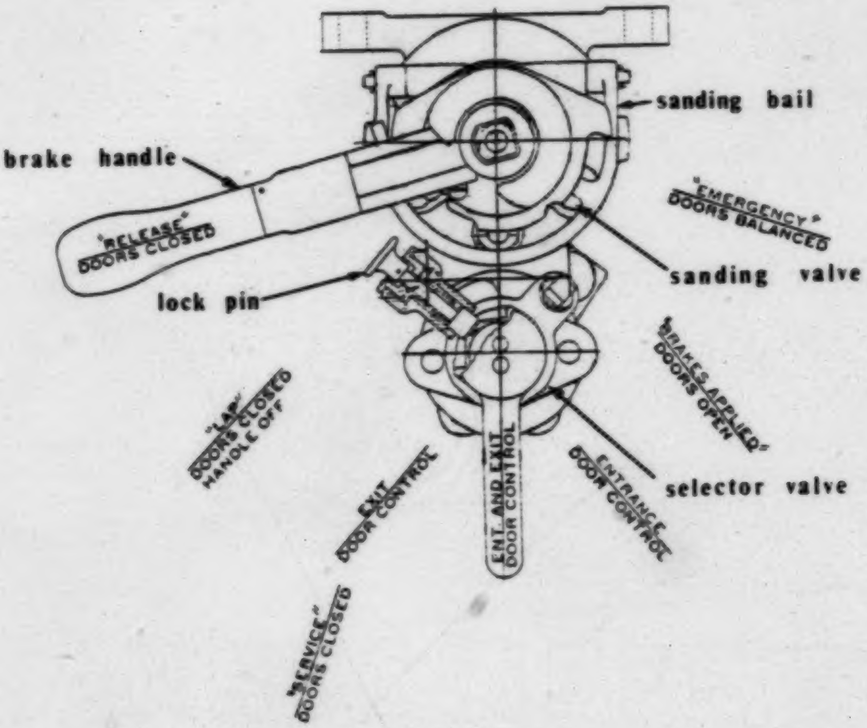

sanding bail
brake handle
"EMERGENCY" DOORS BALANCED
"RELEASE" DOORS CLOSED
sanding valve
lock pin
"BRAKES APPLIED" DOORS OPEN
"LAP" DOORS CLOSED HANDLE OFF
EXIT DOOR CONTROL
ENT. AND EXIT DOOR CONTROL
ENTRANCE DOOR CONTROL
selector valve
"SERVICE" DOORS CLOSED

FIGURE 38. TYPE MD-28 VALVE

position, a whistle was mounted on the letterboard to the right of the front roller sign. (See Plate 31) An additional whistle was placed at the rear of the streetcar beneath the floor. This whistle was operated by the motorman and was used to warn pedestrians and motorists when the streetcar travelled in reverse. (Ottawa Car Manufacturing Co. Specifications, p. 13, and Drawing of Piping Layout)

When the streetcars were complete and in operating condition, they were sent to Edmonton. (Ottawa Car Manufacturing Co. Contract for Streetcars, June 30, 1930) The total weight of each streetcar in this series, including the trucks, was approximately 40,950 pounds (18 575 kg). (Ottawa Car Manufacturing Co. Catalog circa 1931, reprinted 1968,

p. 5A) Although streetcars 80 through 84 were composed primarily of steel, each streetcar was more than 5,000 pounds (2 268 kg) lighter than each of the big Preston streetcars. The lighter weight of streetcars 80 through 84 meant that they would cause less damage to the roadbed than the heavier big Preston streetcars. It is significant to note that streetcars 80 through 84 were the last streetcars to be purchased by the SRD. Plate 31 (Author's Collection) shows the external appearance of streetcar Number 84 sometime during the 1930's. The folding steps, roller bearing trucks and the letterboard whistle should all be noted. The Crouse-Hinds type Z headlight, as well as the route colors on the mirror were added after the streetcar had been in service in Edmonton. Plate 32 (Author's Collection) shows the interior of Number 84. The following should be noted: dome light, leather upholstered seats, small rear bulkhead, centre exit, Agasote ceiling and stanchions.

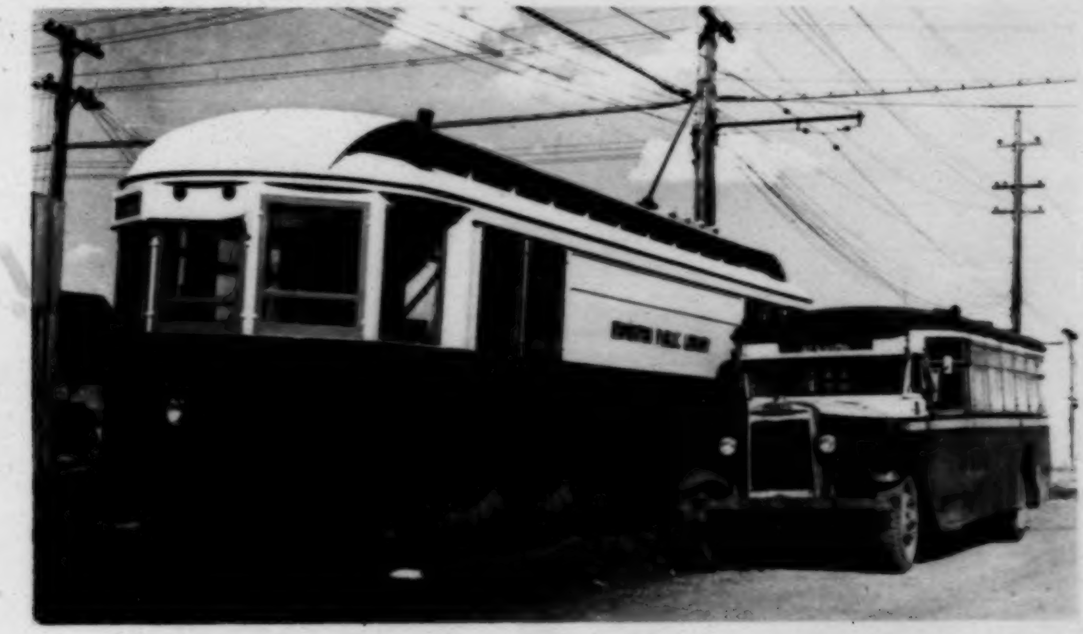
Freight and Service Equipment, 1938

It was noted in Chapter III that by the mid 1930's, serious corrugations had developed along some sections of the SRD's permanent track. A device was needed to smooth the corrugations before they damaged both the rails and the rolling stock.

In 1937, the SRD received from the Toronto Transportation Commission plans for rail grinding apparatus which that company had designed for its street railway. The grinding apparatus consisted of several abrasive blocks which were held in a steel yoke. The yoke was designed so that when it was installed beneath a streetcar, a set of abrasive blocks would be located above each rail. A lever and spring arrangement enabled the blocks to be pressed, with varying degrees of firmness, against the heads of the rails. When the blocks were in this position, they would

Plate 32. (Author's Collection) Interior of Streetcar Number 84

Plate 33. (Provincial Archives of Alberta) Library Car and Bus Number 4



abrade the rails as the streetcar travelled. The plans also called for heavy weights to be placed on the streetcar equipped with the grinders. (Toronto Transportation Commission Drawings of Rail Grinding Apparatus, February 1937) The purpose of the weight was to prevent the abrasive blocks lifting the streetcar rather than bearing down on the rails. A streetcar was needed that could be fitted with both the grinding apparatus and the heavy weights.

The weed killer car, former passenger streetcar Number 7, was ideally suited for this purpose. It possessed no body, it held a large storage tank which could be filled with water, and was not required for most freight or service assignments. In order to be effective, however, the car had to be self-powered. The SRD crews, therefore, reinstalled the two GE-80A-1 motors on the car. Two K-6 controllers were also mounted at each end of the frame. A small wooden platform, supported by four angled wooden posts, was located several feet (mm) above the tank. The platform supported a single trolley base and pole which enabled the grinder car to collect current from the trolley wire. (Photographs in Author's Collection)

In addition to installing the grinding and the electrical equipment, the SRD removed the weed killing apparatus. The brake wheels were replaced by brake handles so that the streetcar could be slowed and stopped easily. Metal stanchions were also placed along each side of the car. In addition, small windshields were placed at both ends of the grinder car. The windshields each supported one Crouse-Hinds type Z incandescent headlight. (Photographs in Author's Collection) The conversion of the weed killer to a rail grinder took place during 1938. The unit was placed in service by the end of October of that year. (Edmonton Bulletin, November 8, 1938, p. 9)

Equipment Modifications, 1931-1945

It should be noted that the depression of the 1930's severely limited the extent of maintenance and modifications carried out on the streetcars. The use of helical gears was discontinued during this period because of their high cost. (SRDAR, 1936, p. 1) It had also been the intention of the SRD in 1931 to install air cooling tanks on each streetcar, thereby reducing the risk of frozen air equipment during cold weather. (Letter to ERR Superintendent W. J. Cunningham from the Standard Iron Works, September 8, 1931) An air cooling tank accepted the compressed air directly from the air compressor. The air from the compressor, being heated, would expand and would drop most of its moisture as condensate in the tank before passing onto the main reservoir and the other air apparatus. The SRD, unfortunately, did not have sufficient funds to undertake this project. (SRDAR, 1931, p. 2) The depressed economic conditions also forced the SRD to obtain its steel castings, such as brake shoes, in Edmonton in order to assist local businesses. In the past, most foundry work had been done by the Manitoba Steel Foundries of Winnipeg. (Letter to Manitoba Steel Foundries from SRD Superintendent W. J. Cunningham, May 8, 1930) The depression also prevented the street railway from installing any Nichols-Lintern traffic lights on any more streetcars. It was noted, in a previous section, that streetcars 80 through 84 were each equipped with the device because it was believed that it would reduce the number of rear end collisions of motor vehicles with streetcars.

It was mentioned in a previous section that streetcars 80 through 84 had been equipped with anticlimbers. In order for the anticlimbers to be effective, each passenger streetcar operated by the SRD had to have anticlimbers as well. The SRD decided to secure a small section of anticlimber onto the bunters of each passenger streetcar. These anticlimbers were fabricated of steel and they contained four ridges each. Two bolts were used to secure each section to the centre of each bunter. (Photographs in Author's Collection) Plate 25 (Author's Collection) shows the anticlimber as it was installed on the front bunter of streetcar Number 29. By the late 1930's every passenger streetcar in Edmonton that was fit for service had anticlimbers in place. (Photographs in Author's Collection)

For several years, the Westinghouse 101-B-2 motors in use by the SRD had been found to be prone to burn outs and shorting. The problem had arisen because the design of the motor armature enabled carbon dust from the brushes to accumulate between the ends of the commutator bars and the interiors of the armature windings. When a sufficient quantity of the carbon dust had accumulated, a current path between the commutator bars and the armature windings was formed. If the insulating varnish was flawed or weak on any portion of the windings, a short circuit would be formed which usually caused that winding to burn out. In an attempt to prevent this condition from occurring, the SRD fabricated a two-piece oak collar which was placed between the ends of the commutator bars and the ends of the armature windings. The collar, which was held in place with wire and insulating tape, prevented the carbon dust from accumulating between the windings and the commutator bars. In this manner, the design flaw of the Westinghouse 101-B-2 motor was overcome. (Letter to Canadian Westinghouse Co. from SRD Superintendent T. Ferrier, August 13, 1945)

The collar was so successful at preventing the armatures of Westinghouse 101-B-2 motors from burning out that other Canadian street railways adopted the use of the Edmonton street railway collar. The collar eventually reached the attention of Canadian Westinghouse personnel who endeavoured to correct the design flaw by changing the size and the shape of the armature windings for the 101-B-2 motor. (Letter and Enclosure to SRD Superintendent T. Ferrier from Canadian Westinghouse Co. District Engineer W. S. Fraser, August 4, 1945)

A previous section also mentioned that streetcars 80 through 84 had been equipped with hand operated windshield wipers. Before 1935, the SRD endeavoured to equip other streetcars in their fleet with a similar type of hand operated wiper. (Letter to SRD General Foreman A. R. Brass from J. G. Brill Co., October 18, 1933) The SRD discovered that hand operated wipers were unsatisfactory since the motormen usually had one hand on the controller and the other hand on the brake valve when the streetcar was in motion. (Letter to E. A. Arnott, Transportation Manager of B. C. Electric Railway Co. from SRD Superintendent T. Ferrier, December 5, 1941)

An air operated wiper manufactured by the National Pneumatic Company was installed on several streetcars in 1936. The wiper was operated by a small cylinder which contained a spring and a small valve in the piston. When compressed air was admitted into the cylinder, the piston would move along the cylinder. The spring inside the cylinder would be compressed during this stroke. When the piston reached the end of its travel, the valve on the piston face would touch a pin on the end of the cylinder. This action caused the valve to open. The resulting loss of air pressure allowed the spring to force the piston back to the other end of the cylinder where the piston valve was closed by another pin. In this fashion, the piston repeatedly reciprocated. The wiper blade was suspended at a single pivot and was connected to the piston by a lever. Every stroke of the piston, therefore, moved the wiper blade across the windshield in an arc. (National Pneumatic Drawings of Windshield Wiper, 1936) The installation of air operated wipers on the Edmonton streetcars was a slow process because of their costs and the prevalent economic conditions.

By early 1940, the SRD was operating several motor and trolley buses. These vehicles all possessed some sort of automatic windshield wiper. On March 9, 1940, the secretary of the local street railway workers' union wrote to the Mayor and the City Commissioners requesting the installation of automatic windshield wipers on all streetcars. The secretary made the point that during snow and rain storms, the visibility was very poor from streetcars that were not equipped with wipers. This condition, it was attested, increased the risk of a serious accident since there were many motor vehicles and pedestrians on the streets at that time. (Letter to the Mayor and Commissioners from Secretary of Local 569 of the Amalgamated Association of Street and Electric Railway Employees of America, March 9, 1940)

In response to this request, the SRD began to equip most of its passenger streetcars with air operated windshield wipers which were manufactured by the Trico Wiper Company. These wipers were similar in construction and operation to the wipers described earlier. In some instances, where a streetcar had a widened windshield, the SRD installed a larger version of the wiper which moved two wiper blades across the windshield. (Letter to B. C. Electric Railway Co. Transportation Manager E. W. Arnott from SRD Superintendent T. Ferrier, December 5, 1941)

Besides windshield wipers, the trolley buses possessed radio interference suppressors which were placed in series with each trolley pole. The suppressors consisted of a metal housing which contained a large choke coil and a capacitor which were connected in parallel. The purpose of the suppressor was to create a high series impedence which would prevent surplus electrical impulses from reaching the trolley wires where they would be "broadcast". If suppressors were not used, the spurious pulses reached the trolley wires. When this occurred, "static" noises were created. Radios in the vicinity of the trolley wires, therefore, could receive this static. (English Electric Co. Specification 4894/1, September 21, 1938, p. 17) The suppressor could also be applied to streetcars in order to achieve the same result. By the end of this period, most streetcars in operation in Edmonton had been fitted with an interference suppressor. One suppressor was placed on each streetcar. The suppressor was bolted to the running board a short distance in front of the trolley pole. (Photographs in the Author's Collection)

The SRD continued to refurbish and to rebuild its rolling stock when required. Two types of front vestibule modifications were introduced during this period on some of the St. Louis built streetcars as well as some of the big Preston streetcars. In order to provide the motorman with a better field of vision to the right, the SRD moved the front roller sign from the right-hand window to the letterboard above the centre window. It should be noted that the roller sign in this location was mounted so that the front glass was flush with the letterboard. The letterboard lenses, however, had to be moved. They were placed on either side of the roller sign. Since the letterboard curved away from the front, the lenses were mounted on short wooden tubes which enabled the lenses to point towards the front of the streetcar. Photographs indicate that twelve streetcars were modified in this fashion. They were: 32, 33, 34, 36, 38, 39, 45, 47, 52, 63, 70 and 78. (Photographs in Author's Collection)

A later version of this modification included the widening of the centre window to increase the motorman's unobstructed field of vision. In this version of the modification, the two window posts were moved towards each side of the vestibule. Thirteen streetcars were modified in this fashion: 35, 41, 43, 44, 48, 57, 59, 65, 66, 71, 72, 73 and 79. (Photographs in Author's Collection) It should be noted that the two aforementioned modifications did not entail substantial rebuilding of the vestibule frames.

A modification to the red and ivory (cream) paint scheme took place during this period. The former practice of placing the streetcar's number in black between the letterboard lenses was dropped in favor of placing the numbers in gold or yellow near both edges of the dashes. This change took place as each streetcar was repainted. (Photographs in Author's Collection) The placement of the numbers on the dash can be seen in Plate 25. The vestibule modifications, as well as esthetic considerations, were probable reasons why the number placement was altered.

The interiors of the streetcars were also modified during this period. The use of Agasote and open bulkheads in streetcars 80 through 84 had made a noticeable improvement to heat circulation and heat retention. By 1936, Agasote was being used to replace the ceilings and the wainscoating on streetcars. In addition, the doors and the partitions in the rear bulkheads were removed to facilitate air circulation. (Letter to the City Commissioners from SRD Superintendent T. Ferrier, December 24, 1936, and Photographs of Streetcar Interiors in City of Edmonton Archives) An attempt was also made to increase the amount of heat that reached the motorman's position. An insulating material, probably wood shavings, was installed between the wainscoating and the exterior sheathing of the vestibule. In addition, a hot air duct was installed in the vestibule from the Peter Smith heater. (Letter to the City Commissioners from SRD Superintendent T. Ferrier, December 24, 1936) The interior modifications also included the floors.

As early as 1928, Superintendent Cunningham had noted that the floors in several streetcars were worn to the extent that they required replacement. It had been found that fir was an unsatisfactory wood for the floors because it was a softwood and it wore away quickly. It had also been discovered that yellow pine, a denser softwood which had been used for the flooring in the St. Louis built streetcars, had lasted a much longer time. (Letter to D. Ackland & Son Ltd. from SRD Superintendent W. J. Cunningham, April 12, 1928)

As each streetcar underwent ceiling and bulkhead modification, the floor boards were replaced. The floor level in the rear vestibule was also raised so that it was level with the body floor. This arrangement prevented passengers from stumbling as they passed from the car body to the vestibule or from the vestibule to the car body. The emergency exit had to be reached by one or two small steps which were placed in a well around the area of the door. To prevent passengers from falling into the well, stanchions and wooden panels were placed on either side. (Photographs of Streetcar Interiors in City of Edmonton Archives)

In 1937, the SRD experimented with the use of roller bearing centre plates on two of their passenger streetcars. It should be recalled that the centre plate bearings then in use by the SRD were grease lubricated sleeve bearings. Big Preston streetcars 56 and 60 were selected to be fitted with roller bearing centre plates since the bolsters on these two units had been moved closer to the centre of their bodies. These streetcars, therefore, had greater body overhang than the other big Preston streetcars. This meant that the bodies of Numbers 56 and 60 would swivel on their trucks more as they travelled through curves. The purpose of the roller bearing centre plates was to reduce friction between the bolster and the truck, which would enable the trucks to swivel easily. This ease in movement would reduce wear on the wheel flanges, thus prolonging their lives. In 1940 after three years in service, it was determined that the roller bearing centre plates had prolonged the lives of the wheel flanges on streetcars 56 and 60, thereby reducing maintenance costs. (Letter to SRD Superintendent T. Ferrier from SRD General Foreman A. J. Brass, June 21, 1940) Although the roller bearing centre plates were successful in reducing maintenance costs, the SRD did not install them on other streetcars. The high initial cost of the roller bearing centre plate assembly was probably greater than the resulting savings in maintenance.

During this period, the Ohio Brass headlights were removed from streetcars 80 through 84 and were replaced by the standard Crouse-Hinds type Z headlight. In addition, the route colors were painted on the back of the motorman's mirror. This did not pose a problem for route changes since these streetcars were continually assigned to the same route. It is probable that the route colors were placed on the mirror because the colored roller signs could not be seen easily during the day. (See Plate 31)

Equipment Disposal, 1938

During 1938, the City and the SRD decided to convert some routes from streetcar operation to trolley bus operation because of the deplorable track conditions along these routes. (CEAR, 1938, p. 9; see also Chapter III) At that time, 50 streetcars were required for daily service while the SRD possessed 77 operable units. (SRDMR, January-June, 1938)

The prospect of reduced streetcar operations enabled the SRD to retire two of its older units. Numbers 10 and 14, which were both in need of considerable painting and repair, were retired by August. (Photographs in Author's Collection, and Edmonton Bulletin, August 13, 1938, p. 9) It should be noted that Number 14 was in fair condition, while the vestibules of Number 10 were sagging badly. (Photographs in Author's Collection) In 1938, it appeared that an operational fleet of 75 streetcars would be sufficient in the future.

Passenger Equipment, 1941

In May, the City Librarian approached the SRD with a proposal to have retired streetcar Number 14 refurbished as a mobile library in order for the library to provide service to residents of outlying areas of Edmonton. The SRD agreed to undertake the necessary refurbishing work on streetcar Number 14 in order for it to be ready for service as a library car by September. (Letter to Librarian H. C. Gourlay from SRD Superintendent T. Ferrier, May 27, 1941) The "Library Car", as it was referred to, was not completed until early October. (Edmonton Journal, October 14, 1941, p. 13)

Several changes had been made to streetcar Number 14. All but four of the body windows on each side had been replaced by boards. The interior was outfitted with bookcases which were secured to the walls of either side. The seats were removed from the interior as well. Interior lighting was provided by the old system of three parallel strips of lamps which ran along the length of the body. Additional lamps were placed over the front and rear doors. (Photographs in Corness Collection) The exterior was painted blue between the base and the belt rail and ivory (cream) above the belt rail. The name "Edmonton Public Library" was placed in black on the centre of each side a few inches (mm) above the belt rail. The belt rail itself was painted black. (Color Photographs in Corness Collection) The blue paint was similar to Pantone ink shade 292C while the ivory was similar to the ivory paint described earlier. (Color Photographs in Corness Collection, and Pantone Matching System Book, 1980)

Plate 33 (Provincial Archives of Alberta) shows the Library Car on the northern leg of the Calder Y sometime during 1946. (See also Chapter III) The bus next to the Library Car is Number 4 which became a library bus. It will be described in a subsequent chapter.

Passenger Equipment, 1946

In March 1943, streetcar Number 28 suffered severe damage as the result of a fire. (Photographs by E. M. Smith) This streetcar could not be placed back in service without extensive rebuilding to the interior and the roof. The ridership on the street railway had increased by such an extent during the Second World War that every serviceable passenger streetcar was required. In addition, the City was restricted by the war-time Federal Transit Controller on the number of new trolley and motor buses it could obtain. (CEAR, 1943, pp. 10-11) By late 1945, the SRD desperately needed equipment. In an attempt to ease the rolling stock shortage, the SRD undertook the reconstruction of streetcar Number 28. The old roof and sides were replaced. The new sashes and arched roof were fabricated so that they resembled the sashes and roofs of the big Preston streetcars. The front vestibule of Number 28 was modified so that the centre window was widened. In addition, the roller sign was mounted in the letterboard above the centre window. (Photograph by E. M. Smith) The interior seating had been destroyed by the fire so replacement seats were taken from the unused observation car. It should be noted that the observation car had been equipped with wooden slat seats. (Photographs by E. M. Smith) The rebuilt streetcar was placed in service by April 1946. (Notations on Photographs by E. M. Smith)

Number 28 was the last streetcar to be extensively rebuilt by the SRD. In 1947, the ETS began to dispose of its streetcars when new motor and trolley buses arrived.

Equipment Disposal, 1947-1952

By October 1947, the ETS had received large shipments of both motor buses and trolley buses. (See Appendix I) The need for streetcars had declined. By the end of December, the ETS had retired four of its oldest streetcars: 3, 4, 5 and 6, that had been in use since 1908. (SRDMR, September-December, 1947, and Photographs in Corness Collection) These retired streetcars were subsequently stripped of: motors and electrical controls, trucks, air brake apparatus, seats, heaters and in some instances, the windows. The units were then offered for sale to individuals at varying prices for use outside the City. (Correspondence between ETS Assistant Superintendent D. L. MacDonald and Various Individuals, May 1948-October 1951)

The remaining streetcars were removed from service and were disposed of in the same manner as the system began to abandon its trackage. (See Appendix I, and Chapter III) With the termination of streetcar operations in September 1951, the ETS disposed of most of its remaining streetcars except for Numbers 80 through 84. These four streetcars were retained for possible resale as operating units. When no buyers were found for these units, they were later stripped and sold. In the case of streetcars 82 through 84, they were destroyed by the

ETS. (Photographs in City of Edmonton Archives; See Appendix I) Streetcar Number 1 was also retained complete for possible historical preservation. It was unfortunate, however, that Number 1 was stored out of doors where it was ravaged by the elements and by vandals. In addition, several streetcar bodies, including the wrecker car (Number 6) were used as storage sheds near the Cromdale car barns for several years. (Photographs by E. M. Smith)

The salvaged seats, heaters and windows were also sold to individuals, while the trucks, electrical equipment and air brake apparatus were sold for scrap. (Correspondence between ETS Assistant Superintendent D. L. MacDonald and Various Individuals, February 1950-June 1952)

THE UNIVERSITY OF ALBERTA

A Technological History of Municipally Owned Public Transportation in Edmonton, 1893-1981

by

(C) George H. Buck

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Chapter VI

Motorbuses

Introduction

Following the end of the First World War, several automobile manufacturers developed motorbuses which were proven to be reliable enough for urban transit service. By the early 1920's, several North American street railways had begun operating some sort of motorbus service to supplement their street railway service. (Miller, 1940, p. 154) The major advantage of a motorbus over a streetcar was that a motorbus did not require an elaborate and costly fixed roadbed. In addition, the routing of a motorbus could be altered daily if required. Costly re-laying of streetcar track was necessary to alter a streetcar route. The motorbus of that period, however, possessed several disadvantages. They could not carry as many passengers as most double truck streetcars. The motorbuses, as well, required more frequent and more elaborate maintenance than most streetcars. It should be noted that the internal combustion engines of that era and their drive systems possessed a far greater number of moving parts than the motors and control equipment of electric streetcars of that era. A motorbus, however, could be more economical to operate than a streetcar on routes with low ridership and poor track.

It has been mentioned in previous chapters that several ERR stub lines had been unremunerative since their construction. These lines included the track along 76th Avenue between 104th and 116th Streets, commonly referred to as the McKernan's Lake line, and the short stub line along 102nd Avenue between 124th and 142nd Streets. (Edmonton Official Gazette, April 9, 1914, p. 61; see also Chapters III & V) In

September 1928, SRD Superintendent W. J. Cunningham reported to the City Commissioners that he was in favor of abandoning streetcar service along 76th Avenue and replacing it with a motorbus because that line had perpetually lost money as the result of low ridership. In addition, Cunningham pointed out that the track was in serious need of extensive repair. It was also Cunningham's intention to alter the route in order to serve the University of Alberta. Superintendent Cunningham believed that the small size of the motorbus, combined with low road maintenance costs, would reduce the yearly losses along the McKernan's Lake line. (Letter to the City Commissioners from SRD Superintendent W. J. Cunningham, September 20, 1928)

Many of the local residents in the area of the western end of the line were vehemently opposed to any change in the service. In addition to letters and a petition, the residents cited the Edmonton-Strathcona Amalgamation Act of 1912 which stipulated that a streetcar line along 76th Avenue was part of the Agreement. (Statutes of Alberta, 1911-1912, Chapter 66, pp. 529-530, and Letters and Petition from W. H. Alexander to the City Commissioners and SRD Superintendent W. J. Cunningham, December 1928-June 1929) The actions persuaded the City to abandon its plans to implement motorbus service along the McKernan's Lake line.

Superintendent Cunningham, however, continued to investigate other modes of transportation vehicles which could be used to supplement streetcar service. In 1930, Cunningham met with a H. J. Griswold who was a heavy equipment supplier. Griswold mentioned the development of the electric trolleybus in England and how it was replacing the streetcar in that country because of its versatility. (Letter to SRD Superintendent W. J. Cunningham from Griswold & Co., June 18, 1930) Trolleybuses were able to use the same electrical apparatus as streetcars but trolleybuses did not require the expensive fixed roadbed that streetcars required.

In 1931, the City again decided to investigate the possibility of bus operations. The small stub lines had continued to lose money. In addition, other areas of Edmonton not served by streetcars desired transit service. An investigation committee was formed early in 1931 to make suggestions to the City Council. The committee consisted of Superintendent Cunningham and two aldermen. (Canadian Railway and Marine World, March 1931, p. 171) By July, the committee had recommended that motorbuses replace the existing streetcar service along 102nd Avenue and that a motorbus route be implemented between the 109th Street streetcar lines and the buildings of the University of Alberta. During this time, the tracks on the High Level Bridge were undergoing extensive repairs so streetcar service across the bridge was temporarily suspended. To keep passenger inconvenience to a minimum, a temporary motorbus service was operated across the bridge until the track repairs were finished. The temporary bus service provided the committee with an excellent opportunity to observe closely urban bus operation. (Canadian Railway and Marine World, July 1931, p. 478)

In August, the City Council decided to invite tenders for motorbuses. The buses would be used to replace streetcar service along 102nd Avenue. The buses would also be used on a new route which would link the University with main streetcar lines. (Canadian Railway and Marine World, October 1931, p. 667) The decision to abandon street railway service along 102nd Avenue was given impetus because one of the wooden bridges on that section of track was in serious need of reconstruction. (Letter to the City Commissioners from SRD Superintendent W. J. Cunningham, January 27, 1932) In order to rebuild the bridge, streetcar service would have to be suspended or diverted. The cost of constructing a street railway diversion would have been extremely expensive compared to the cost of operating a motorbus.

In a report to City Council, Superintendent Cunningham pointed out that recent advances in transportation technology, such as the trolleybus, were beginning to make the use of streetcars obsolete. (Canadian Railway and Marine World, November 1931, p. 723) It would be several years, however, before trolleybus operation began in Edmonton. Although trolleybuses were superior to streetcars in many respects, they were more expensive than motorbuses and trolleybuses were not widely used in North America at that time. (Canadian Railway and Marine World, p. 731)

The question of replacing streetcar service along the McKernan's Lake line again became a topic of discussion in 1931. Superintendent Cunningham still desired to alter the route and to replace the streetcars with motorbuses. The local residents, as well, were still opposed to his ideas. The City Council decided to settle the question by holding a plebiscite on November 11. In order for the plebiscite to pass (enabling streetcar service along 76th Avenue to be abandoned), a two-thirds majority vote was required from the residents on both sides of the North Saskatchewan River. The votes were recorded separately in accordance with the Edmonton-Strathcona Amalgamation Act. Although the north side voted in favor of altering the McKernan's Lake line, the plebiscite was defeated by the voters on the south side of the river. (Canadian Railway and Marine World, December 1931, p. 785) Motorbuses would not replace streetcars along that line for several years.

On December 9, 1931, Superintendent Cunningham submitted a report to the City Council which included a summary of the bids received for motorbuses as well as Cunningham's recommendations for purchase.

The report noted that most motorbuses consisted of a modified truck chassis on which was mounted a streetcar-like body. In addition, it was mentioned that buses could either be purchased as complete units or they could be purchased as a chassis only, with the body being fabricated locally. (Report to the City Commissioners, December 9, 1931, pp. 1-3) Most of the bus builders stated that their chassis would be powered by some sort of gasoline engine. One manufacturer, Seldon Motors of Vancouver, British Columbia, stated that a diesel engine would be used to power their chassis. Cunningham did not consider that bid because he believed that the diesel engine was still in an "experimental stage" and was not a proven prime mover. (Report to the City Commissioners, December 9, 1931, p. 4) Of twelve bids received, Cunningham recommended that three 25 passenger capacity motorbuses be purchased from the Canadian office of the General Motors Company. One of the units was to be complete, while the other two would have bodies fabricated in Edmonton. (Report to the City Commissioners, December 9, 1931, p. 3)

In early December the Leyland Motors Company brought a 21 passenger demonstrator bus to Edmonton in an attempt to convince the City officials that their product was better suited for service in Edmonton than their competitors' product. The unit did not remain in Edmonton for a long time. By the end of December, it had been transported to Vancouver. (Canadian Railway and Marine World, January 1932, p. 39) Cunningham was impressed with the operation and by the price of the Leyland demonstrator bus and he decided to alter his recommendations to the City Commissioners for bus purchases. The new recommendation called for the purchase of one complete 21 passenger Leyland bus and two 25 passenger General Motors chassis. (CECR No. 5, December 14,

1931) On December 30, the City Council approved the immediate purchase of a single 21 passenger Leyland bus but postponed making a decision on the chassis. (letter to the City Commissioners from the City Clerk, December 31, 1931) Motor bus operation by the SRD would begin in early 1932.

Equipment Purchases, 1932

The previous section noted that a 21 passenger Leyland bus was ordered by the City in December 1931. In order for the City to receive the bus immediately, Leyland agreed to sell the demonstrator bus to the City. This was the same bus that had operated in Edmonton for a brief period in early December. Both the bus chassis and motor had been manufactured in England, while the body had been fabricated in Montreal. The chassis was designated as "Cub", or LKP3. The chassis frame was fabricated from steel channel. The frame consisted of two side sills which were braced by several cross sills. All members of the frame were bolted together. (Leyland Motors Ltd. Specifications of "Cub" LKP3 Passenger Chassis, 1931) The frame was supported by two transverse axles which were placed near each end of the frame. The front axle, which was of forged nickel steel, was fitted with steering gear as well as drum brakes at each end. A single tube (balloon) tire and split rim was bolted to studs which were attached to the brake drums. The axle was partially suspended by leaf springs which were attached to the side of both side sills. The rear axle, also composed of nickel steel, was entirely free from the frame. The axle was held in position by two leaf springs which allowed the entire axle to undulate vertically. The centre of the rear axle contained an underslung worm-drive differential. (Leyland Motors Ltd. Specifications) A worm-drive differential consisted of a large steel casting which housed a large diameter helical gear and differential assembly which were mounted on the axle. The housing also contained a worm gear which was held in contact with the underside of the helical gear. The worm gear was rotated by a driveshaft which connected the worm gear to a gear box. The differential enabled torque to be transmitted from the driveshaft to the rear axle. The differential also enabled each rear wheel to rotate at different speeds, a feature that was desirable when the bus turned a corner. The worm-drive differential, which was designed to be quieter in operation than other types of differentials of that time, was commonly used on trucks and buses during this period. (Specifications of Bus and Truck Chassis in SRD Superintendent Cunningham's Report to the City Commissioners, December 9, 1931) Dual balloon tires were placed at each end of the rear axle, since most of the body weight would be placed above the rear axle. (Leyland Motors Ltd. Specifications)

An inline, six cylinder water cooled engine was mounted lengthwise near the front of the chassis between the side sills. The engine consisted of a cast iron block which held replaceable cast iron cylinder liners. The cylinder head and the pistons were also made of cast iron. The oil sump, however, was cast aluminum. Aluminum was used in order to reduce the total weight of the engine. A radiator was mounted directly in front of the engine. Air was drawn past the radiator cores and fins by a four-bladed steel fan which was driven by a belt, thus cooling the liquid in the radiator. The belt was attached to a pulley which was connected to the end of the engine's camshaft. The ignition system consisted of a coil and a distributor. Spark advance was semi-automatic and could be controlled by a lever mounted on the side of the steering column below the steering wheel. An electric starter was provided with the engine in addition to a hand crank which was connected to the front end of the engine's crankshaft. In most instances, the starter motor was used. The electrical system consisted of two 12 volt lead-acid batteries, connected in parallel, which were kept charged by one 180 W generator. The generator was driven by a belt which was attached to a crankshaft pulley at the front of the engine. A single carburetor, mounted on the cylinder head, provided the required gas and air mixture for the engine. The gas tank, which was fabricated of steel plate, was bolted to two steel brackets located on the left-hand side of the frame. The tank had a capacity of 24 imperial gallons (109 L). The exhaust system consisted of a pipe which ran from the engine's exhaust manifold to the right-hand side of the frame immediately in front of the rear wheel. A single muffler was placed in the pipe between the engine and the end of the pipe. Despite the engine's seemingly large size, it was capable of producing a maximum output of only 68 H.P. (50.7 kW). (Leyland Motors Ltd. Specifications; see also Appendix I) The engine was enclosed by a two-piece sheet steel shroud. The shroud was hinged in the middle to enable each half to be lifted so as to permit access to the engine area. Metal fenders, which were designed to shield the front tires, were also attached to the front of the chassis. (Leyland Motors Ltd. Specifications)

A manual gear box and a drive shaft connected the crankshaft and the flywheel of the engine with the differential. A pedal operated single-plate friction clutch enabled the engine to be disconnected from the gearbox. The gearbox contained four forward gears and a single reverse gear. (Leyland Motors Ltd. Specifications) It should be noted that truck and bus gearboxes of this period did not possess synchromesh features. Gear changes frequently resulted in the improper meshing (grinding) of the gears unless the bus operator depressed the clutch pedal twice (double clutching) before trying to engage a new gear. The gear shift lever was mounted on top of the gearbox and was designed to protrude through the floor of the bus body next to the operator. (Leyland Motors Ltd. Specifications)

Hydraulically operated drum brakes were installed behind each wheel. The brakes were activated by means of a foot pedal placed to the right of the clutch pedal. A handbrake lever, mounted next to the gear shift lever, pulled two steel cables which applied the rear brakes manually. The chassis also came equipped with a single spare tire which was mounted in a cradle on the underside of the frame at the rear. The chassis also was equipped with a single automobile-type electric horn, a speedometer which was mounted on a panel near the steering wheel, a hand operated tire pump, and two incandescent headlights which were mounted on the front of the chassis to either side of the radiator. (Leyland Motors Ltd. Specifications) The chassis was shipped to Canada (where bodies were installed) in this configuration.

The body supplied with the Leyland demonstrator bus was manufactured in Montreal by the Canadian Car and Foundry Company. (Canadian Car & Foundry Co. Specifications for 21 Passenger Body for Leyland Chassis, 1931, p. 1) The construction was similar to the body construction of some of the ERR's wooden streetcars. The floor and the side framing of the bus body consisted of ash posts. The body framing was bolted to the chassis side and cross sills. The flooring consisted of tongue and groove British Columbia fir boards which were screwed to the ash framing with wood screws. The entire floor area was covered with ¼ inch (6 mm) thick linoleum. The aisle areas were also covered with a corrugated rubber matting. The roof, which was arched, consisted of basswood boards which were covered with Number 10 weight canvas duck which was then covered with a water proofing compound. Four ventilators were also placed in the roof. (Canadian Car & Foundry Co. Specifications, pp. 1-3)

The left-hand side was framed for four windows and an outward-opening emergency door at the rear. The window sashes were fabricated of brass and were designed to lift a short distance, except for the window next to the operator and the window in the emergency door. All side windows were equipped with a removeable storm sash. The lower quarter of the operator's window was fabricated so that two glass panels could be slid open. The emergency door window was stationary, however. The right-hand side contained four windows in addition to a single-width folding door which covered a two step metal stairwell. The folding door, which was made from cherry wood, was operated by a hand lever mechanism which resembled the apparatus used on most SRD passenger streetcars. (Canadian Car & Foundry Co. Specifications, p. 1, and Photographs in University of Alberta Archives) The rear of the body contained a single fixed window while the front, which ended at the rear of the engine, contained a flat windshield angled backwards a few degrees in order to reduce glare. The area behind the engine (the dash) was framed in sheet steel which was covered with mahogany veneer. A metal sun visor was mounted above the windshield on the exterior, as well as a hand operated windshield wiper. Two small trapezoidal windows which could not be opened were also placed between the windshield and each corner post. The area between the windshield and the roof contained an illuminated roller sign in addition to two colored lenses which were located on either side. (Photograph in Glenbow Archives)

The exterior sheathing as well as the interior wainscoating and ceiling consisted of sheet steel which was fastened to the framing with screws. Number 22 gauge steel was used for the interior, while Number 20 gauge steel was used for the exterior panels. The space between the exterior sheathing and the interior wainscoating was insulated with a layer of felt. A small rear bumper, fabricated from steel channel, protected the rear of the body from minor blows. The bumper was attached to the chassis by a small leaf spring arrangement which imparted some horizontal flexibility to the bumper. An illuminated license plate holder as well as a red stop lamp were mounted on the rear of the body. (Canadian Car & Foundry Co. Specifications, p. 2) It should be noted that while streetcars did not require licenses because their movement was usually restricted to certain types of roadbeds, motorbuses could traverse any road that could be used by any other motor vehicle. It is for this reason that motorbuses had to be licensed.

The interior seating consisted of fixed cross seats in addition to two short longitudinal seats which were placed over each rear wheel well. The operator's position was also provided with a seat. All seating was upholstered in brown leather. Ceiling mounted handrails were provided above each row of seats. The rails consisted of ash dowels which were finished to resemble mahogany. Steel brackets secured to the ceiling held the handrails in position. A single aluminum stanchion was placed to the left of the front door, while another stanchion was placed to the right of the operator. This stanchion held the farebox and a small diameter steel rod which held a canvas curtain which was used to shield the operator from the interior lights of the bus. (Canadian Car & Foundry Co. Specifications, pp. 1-3) The interior lighting was provided by six small dome lights placed in two rows of three fixtures, each row being placed above one row of seats. Each fixture contained a single 12 volt incandescent bulb which received its power from the engine's batteries. A single radiator-type heater was placed to the right of the operator's position. This heater obtained heat from the engine's coolant which was circulated through it. A small electric fan forced air through the heater. In this manner, the interior of the bus was heated. The interior signal system consisted of a buzzer. The buzzer was activated by two spring switches which were normally open. A rope attached to each switch and strung along either side of the body above the windows enabled passengers to activate the buzzer. (Canadian Car & Foundry Co. Specifications, p. 2)

When the Leyland bus arrived in Edmonton in early January 1932, it required repainting as well as an addition to the braking system before it could be placed in service. In order to provide faster braking, Superintendent Cunningham had a vacuum operated brake booster installed on the bus. (SRD Internal Memorandum) The operation of the booster was similar to the operation of brake boosters found on many contemporary trucks and automobiles.

The bus was painted in the red and ivory (cream) color scheme that had been applied to the streetcars during that period. The red paint was applied below the windows while the ivory was applied between the red paint and the roof, which was painted black. The name "Street Railway Department" was painted in black on the centre of each side immediately below the windows. In addition, the number "1", also in black, was placed on each front corner post. (Photograph in Glenbow Archives) Once these modifications were complete and the bus was licensed, it was ready for service.

Bus Number 1 was placed in service on 102nd Avenue beginning January 25, 1932. Streetcar service along that route was terminated on the previous day and work began on the replacement of the bridge near 131st Street. The closure of the bridge meant that streetcar operation could not be resumed if the bus broke down. Superintendent Cunningham, therefore, asked the City Commissioners to allow the immediate purchase of an additional complete bus. (Letter to the City Commissioners from SRD Superintendent W. J. Cunningham, January 27, 1932) A special meeting of the City Council on January 28 authorized the purchase of one complete bus and a General Motors chassis with the body to be built in Edmonton by the Fane Auto Works Limited. (Letter to the City Commissioners from the City Clerk, January 29, 1932) The only company which could supply a complete unit in a short time was the White Truck Company. The bus consisted of a White model 613 bus chassis on which was added a Canadian Car and Foundry 21 passenger body. (SRD Internal Memorandum)

The White chassis was similar in appearance and construction to the Leyland chassis. There were some differences, however. The differential did not employ the common worm-drive. A bevel gear arrangement was used instead and was similar to the design of contemporary automobile differentials. In addition to springs, the White chassis came equipped with hydraulic shock absorbers which were mounted by each wheel. (White Truck Co. Specifications of Model 613 Passenger Bus Chassis, February 1930) It is probable that the White chassis provided a smoother ride than the Leyland chassis because of the shock absorbers.

The body was similar in appearance to the body of bus Number 1. (SRD Internal Memorandum) When the second bus arrived in Edmonton, it was painted in a similar manner to bus Number 1. The White/Canadian Car and Foundry bus was numbered "2". (See Appendix I)

The General Motors bus chassis was designated as model U and was designed to support a 25 passenger body. (SRD Internal Memorandum) The chassis was quite similar to the chassis of bus Number 1, in that it possessed a worm-drive differential and did not possess shock absorbers. A larger engine and gasoline tank were supplied with this chassis. The gasoline tank was designed to hold a maximum of 38 imperial gallons (173 L) of regular gasoline. A Buick inline six cylinder engine was supplied with the chassis. While the block and the cylinder were cast iron, the pistons were composed of a special aluminum alloy which provided for rapid heat dissipation. (General Motors Coach Specifications of Model U, August 1930) It should be noted that this engine was the first mechanical unit purchased by the SRD that used a light aluminum alloy for some of its moving parts. The use of lighter metals, alloys and compounds would become commonplace in future units purchased by the SRD.

The hand brake supplied with this unit operated a special drum brake which was located immediately beyond the gear box. The brake shoes were attached to the gear box while the drum was secured to the drive shaft. When the brake lever was pulled, the brake shoes would slow and stop the rotation of the drive shaft. (General Motors Coach Specifications, August 1930, p. 4) The use of a special drum for the handbrake decreased the likelihood that all braking capacity would be lost on the bus at one time.

The body for this chassis was fabricated by the local firm of Fane Auto Works Limited. The basic construction of the body was similar to that used for the Canadian Car and Foundry bodies except sheet aluminum was used for both the exterior sheathing and the interior wainscoating and the ceiling. The body, which was longer than the Canadian Car and Foundry bodies, was also equipped with two hot water heaters, one at the front and the other at the rear of the bus. (Fane

Auto Works Ltd. Tender for Motor Bus Body, January 28, 1932) The use of aluminum greatly reduced the weight of the body which, in turn, reduced the weight on the chassis and the consequent wear.

The body was painted in the same manner as buses Numbers 1 and 2. This unit was numbered "3". Plate 34 (Glenbow Archives) shows the external appearance of bus Number 3 at the Fane Auto Works upon its completion in April 1932. Plate 35 (Glenbow Archives) shows the interior view of the bus at this time. The photographer was standing near the front of the body and was facing the rear of the bus. The leather upholstered seats as well as the handrails should be noted.

The maintenance and the storage of the three motorbuses could not be undertaken by the SRD since their facilities were designed for the servicing and storage of streetcars. In addition, most SRD shop employees were not qualified motor mechanics. In order for the buses to receive the proper maintenance and storage, they were placed under the care of the Civic Garage. The Civic Garage stored, serviced and repaired the buses and billed the SRD for the costs. Painting and body work, however, were undertaken by the SRD at the Cromdale car barns. (Civic Garage Summary and Details of Operation of Street Railway Buses, 1936) It should be noted that only licensed SRD operators could drive the motorbuses. Most SRD motormen of that period could not operate the buses since many of them were not licensed to operate an automobile. (Letter to ETS Superintendent T. Ferrier from Civic Garage Superintendent A. W. Allbright, January 17, 1946)

Equipment Modifications, 1936

As early as 1935, concern was expressed over the high operating costs of the three buses. The purchase of gasoline accounted for 63%

Plate 34. (Glenbow Archives) Bus Number 3 in 1932

Plate 35. (Glenbow Archives) Interior of Bus Number 3

of the total operating cost of these buses. (Civic Garage Summary and Details of Operation of Street Railway Buses, 1936) The three buses were not very fuel efficient. Bus Number 1 travelled approximately eight miles (13 km) on one imperial gallon (4.5 L) of gasoline. Bus Number 2 averaged seven miles (11 km) to one gallon (4.5 L), while bus Number 3 could travel only six miles (10 km) on one gallon (4.5 L) of gasoline. (Civic Garage Summary and Details of Operation of Street Railway Buses, 1936) A solution had to be found to the high fuel consumption or the operating costs of the buses would become prohibitive in proportion to the ridership.

During 1935, the SRD and the Civic Garage personnel investigated developments with the diesel engine. It was discovered that the average six cylinder diesel engines which were suitable for use in motorbuses consumed approximately one imperial gallon (4.5 L) for every 18 miles (29 km) travelled. This amount represented a considerable reduction of fuel consumption compared to gasoline powered engines. In addition, the cost of diesel oil in 1935 was considerably less than the cost of gasoline. (Civic Garage Summary and Details of Operation of Street Railway Buses, 1936) In early 1936, the SRD and the City Commissioners decided to invite tenders for replacement diesel engines for their bus fleet.

Several companies showed interest but only one firm offer was received. The offer came from the Waterous Company which sold Leyland engines. The use of the English-made Leyland diesel engine in Canadian motorbuses was becoming quite widespread since there was a six month backlog of orders at the Leyland factory. (Letter to the City Commissioners from Waterous Ltd., June 15, 1936) Although the Leyland diesel engine was more fuel efficient than the gasoline engines then in use by the SRD, the diesel engine was also extremely expensive. The City officials decided, therefore, to equip only two of the three buses with the Leyland diesel engines. Bus Numbers 1 and 3 were selected for conversion to diesel engines. (Letter to the City Commissioners from Waterous Ltd., November 6, 1937; See also Appendix I)

The Leyland diesel engine embodied many features that are found on contemporary engines. While the engine block and the cylinder head on this diesel engine were both cast iron, the pistons and the crankcase were cast of an aluminum alloy. An overhead camshaft and valve mechanism was employed to reduce the number of moving parts in the engine. The interior of the cylinder head above each cylinder was hemispherical in order to induce turbulence within the cylinder when fuel was injected. Bosch Corporation direct-type injectors and a Bosch fuel pump were installed on the engine as well. (Leyland Motors Ltd. Specifications of Oil Engine) The engine also came equipped with an integral clutch and gear box. While a starting crank was provided, the engine came equipped with a Bosch 24 volt starter motor which obtained its power from the two 12 volt batteries in the bus. It should be noted that the design of the combustion chamber described above eliminated the need of glow plugs to ignite the air-fuel mixture at any time, including starting. (Leyland Motors Ltd. Specifications of Oil Engine)

By July 1937, the SRD had concluded that the diesel engine had resulted in considerable savings in fuel costs. (Letter to the City Commissioners from SRD Superintendent T. Ferrier, July 7, 1937)

Leased Equipment, 1938-1945

The need for additional motorbuses was acute since the SRD was committed to starting new bus routes. In order to provide transit service to the residents of the Forest Heights district, the City entered into a temporary agreement with the Bus Universal Supply Company of Alberta Limited in November 1938. That company supplied and operated two fully-equipped 21 passenger General Motors Coach (GMC) motorbuses along that route. By the end of September 1939, the company wished to have a firm agreement if they were to continue the bus service. It was apparent to the City Commissioners that the bus service was needed by the residents of the Forest Heights district. It was also apparent that the SRD did not have, and would not have in the near future, sufficient motorbuses to operate the route themselves. The City, therefore, concluded a firm Agreement with the Bus Universal Supply for their continuation of bus service with the buses mentioned previously until November 15, 1941. (Agreement between Bus Universal Supply of Alberta Ltd. and the City of Edmonton, October 2, 1939, pp. 1-4)

During 1940, an aircraft repair facility was opened near the southern end of the Municipal airport near Kingsway Avenue and 124th Street. The military authorities requested that the City provide some sort of transit service between the facility and the centre of the City. The SRD did not have a sufficient number of motorbuses to undertake this service. The City Council, following the recommendation of the City Commissioners, entered into an agreement with the Checker Taxi Cab Company during October 1940. That Agreement stipulated that the Company was to operate two buses on the route described above until six months after the conclusion of the War. (Minutes of City Council Meeting, October 15, 1940) It is not known what type of motorbuses were used by that Company during this period.

It was apparent to the City Commissioners that additional motorbuses were required if the SRD was going to be able to provide service on any new routes.

Used Equipment, 1939

Economic constraints had prevented the SRD from purchasing additional buses after 1932. However, the SRD was in need of more motorbuses as soon as possible because of new routes and increased ridership on existing routes. In August, the Toronto Transportation Commission (TTC) informed the City Commissioners that the TTC was preparing to sell several surplus Leyland motorbuses. The SRD, in turn, informed the Commissioners that one such bus might be suitable for use as a reserve unit for the buses in regular service. The City Commissioners then employed a representative of Leyland Motors to inspect the buses and to recommend the best one for purchase. (Letter to the TTC from Commissioners R. J. Gibb, August 26, 1939) Following the inspection of the buses, the Leyland representative recommended that the City purchase bus Number 558. (Letter to Commissioner R. J. Gibb from Leyland Motors Ltd., August 24, 1939) After further inspections, the City agreed to purchase Number 558 from the TTC, and had it sent to Edmonton by rail in September 1939. (Letter to the City Commissioners from the TTC, September 1, 1939)

Bus Number 558, purchased from the TTC, had a capacity of 27 passengers, and a Leyland "Lioness" chassis and engine which were similar in construction to bus Number 1 of the Edmonton fleet. (See Appendix I) Air operated drum brakes were supplied with this bus rather than hydraulically operated drum brakes. The body of Number 558 was somewhat different from the body of SRD bus Number 1. Apart from its larger size, the body of Number 558 was constructed by the TTC and it contained a treadle-operated rear exit door on the right-hand side.

The door was opened by means of an air cylinder. (TTC Specifications of Buses 550 to 564, Excepting 557, 1939) It should be noted that bus Number 558 was the first piece of used rolling stock to be purchased by the SRD. (See Appendix I)

Upon arrival in Edmonton, the bus was repainted in a new version of the SRD's red and ivory (cream) paint scheme and was numbered "4". In addition to the red and ivory, the paint scheme was expanded to include an orange band which was bordered along the top and the bottom by thin black lines. The orange band was located immediately below the body windows and was placed around the body, with the exception of the radiator. The orange resembled Pantone ink shade 151C. (Color Photograph by H. Hollingworth, and Pantone System Matching Book, 1980) The number of the bus, painted in black, was placed immediately above the orange band on each front corner post. Plate 33 (Provincial Archives of Alberta) depicts bus Number 4 as it appeared in 1946. The placement of the orange band and the number should be noted.

New Equipment, 1939-April 1940

In late 1939, the SRD ordered one new diesel-powered motorbus from Leyland through the local dealer, Waterous, Limited. (Canadian Transportation, December 1939, p. 615) The bus consisted of a Leyland "cub" chassis with a model H2B six cylinder diesel engine. (Letter to the City Commissioners from Waterous Ltd., May 18, 1940) The body, manufactured by Smith Brothers Motor Body Works of Toronto, was described as a "transit" or "city" type. (Letter to the City Commissioners from Waterous Ltd., November 6, 1937, and Quotation from Leyland Motors Ltd., January 18, 1940)

A transit or city bus body was one in which the body extended from the extreme front to the extreme rear of the chassis although the motor was placed longitudinally at the front of the chassis. The motor was enclosed by a removeable steel shroud and a grill placed in front of the body enabled air to reach the radiator. By designing the body in this manner, additional seating could be installed.

The body framing consisted of high tensile steel members which were arc welded together, generally. The left-hand side of the body was framed for six rectangular metal-framed windows in addition to a small fixed trapezoidal window near the front of the body. It should be noted that an emergency door was located at the rear of the left-hand side of the bus. The right-hand side, however, contained two single-width doors. The front door was placed immediately behind the front wheel, while the other door was placed immediately in front of the rear wheel. (Canadian Transportation, February 1940, p. 92, and Author's Inspection of Bus Number 5) The doors, constructed of wood, were air operated. The front door was intended as an entrance while the rear door was to be used as an exit only. Each half of the front door swung into the step well, while each half of the rear door swung out. The windshield was in two separate sections so as to conform to the curvature of the body. The windshields were kept clear of snow and rain by vacuum operated windshield wipers which were placed above each windshield section. (Leyland Motors Ltd. Specifications of City Transit Body, 1939) The vacuum operated wipers functioned in a similar fashion to the air operated wipers that were described in Chapter V. The intake manifold of the engine provided the necessary vacuum to operate the wiper pistons. The rear window, like the windshield, was also in two separate sections. Safety glass was used in the body windows to reduce the likelihood of passenger injury should a window be broken. In addition, a set of winter sashes was provided for each body window on each side. (Canadian Transportation, February 1940, p. 92) It should be noted that while the body framing was steel, linoleum covered wood flooring continued to be used. (Leyland Motors Ltd. Specifications of City Transit Body, 1939)

The seating was arranged to accommodate 32 passengers. The seats consisted of tubular steel frames to which were attached foam cushions which were covered in brown leather. (Canadian Transportation, February 1940, p. 92) It should be noted that tubular framed seats were not as rugged or heavy as the previously used streetcar-type seats.

The exterior sheathing, including the roof, consisted of 20 gauge sheet steel. The panels were riveted in some areas, while aluminum molding strips and screws were used to secure the panels in areas prone to damage. (Canadian Transportation, February 1940, p. 92, and Leyland Motors Ltd. Specifications of City Transit Body, 1939) It should be noted that canvas was no longer being used for the roofs. This development marked a departure in bus body construction from traditional construction methods and materials that were used previously in streetcar body construction.

The headlights were mounted onto the front body panels and a small indicator or "clearance" lamp with a colored lens was placed on either side of the roller sign. The roller sign was located immediately above the windshield. Similar clearance lamps were placed at the corners of the bus at the rear. The interior lighting was also supplemented by a lamp which was placed in each stair well and a lamp mounted in the emergency door would become illuminated if the door was opened. A rear view mirror was also supplied with the bus. It was mounted on the left-hand side of the body on the front corner post. (Photographs in Corness Collection, and Leyland Motors Ltd. Specifications of City

Transit Body, 1939)

The body was painted and numbered before the bus was sent by rail to Edmonton. (Leyland Motors Ltd. Specifications of City Transit Body, 1939, p. 3) The bus was numbered "5". Number 5 arrived in Edmonton during December 1939. (SRDMR, November-December 1939)

The SRD still found itself short of motorbuses at the beginning of 1940. In an attempt to ease the shortage, in February the City Commissioners ordered an additional Leyland bus through Waterous Limited. (Letter to the City Commissioners from Waterous Ltd., February 13, 1940) The bus was identical to bus Number 5 and was numbered "6". Number 6 arrived in Edmonton during April 1940. (SRDMR, March-May 1940)

Equipment Modifications, 1940

Buses Numbers 5 and 6 were initially found to be very difficult to steer and to handle properly since the front axles of these buses tended to bounce excessively. Numerous letters were exchanged between the Superintendent of the Civic Garage and the Toronto office of Leyland Motors, with no positive suggestions coming from Leyland. Superintendent Allbright of the Civic Garage eventually corrected the steering and handling problem by altering the arrangement of the front springs so that they were more rigid. (Letter to the City Commissioners from Civic Garage Superintendent A. W. Allbright, October 23, 1940)

During this period, it is probable that external rear view mirrors were installed on all the other buses in the SRD's fleet. (Photographs by E. M. Smith) The mirrors enabled the bus operators to see vehicles passing on the left.

New Equipment, May-December 1940

The need for additional motorbuses continued despite the arrival of buses Numbers 5 and 6. In May, therefore, the City Commissioners ordered an additional, larger bus from Leyland through Waterous Limited. (Letter to the City Commissioners from Waterous Limited, May 18, 1940)

The longer chassis was designated LTB.S "lioness" and held an 8.6 L six cylinder "Tiger" diesel engine which was slightly larger than the H2B engine which had been supplied with buses Numbers 5 and 6. (Letter to the City Commissioners from Waterous Ltd., May 18, 1940) It should be noted that by this time, the Second World War had severely limited the number of ships travelling to Canada. The Canadian office of Leyland Motors, therefore, was unable to obtain some new parts for this chassis: differential, front axle assembly and the steering gear. (Letter to Commissioners R. J. Gibb from Leyland Motors Ltd., December 2, 1941) Reconditioned items that had been taken from older surplus units were used on the chassis instead of new parts. The Waterous representative of Leyland, however, had neglected to inform the City that reconditioned apparatus had been installed on the chassis. The use of reconditioned items was discovered by the Civic Garage in 1941 when the differential failed. Although the resulting unpleasantness and ill feeling between Leyland and the City caused by this incident was resolved, no Leyland motorbuses were purchased by the City after 1941. (Correspondence between Commissioners R. J. Gibb and Leyland Motors Ltd., November 27, 1941-December 16, 1941)

The body for this unit was fabricated by Smith Brothers Motor Body Works and was similar in construction and appearance to the bodies of buses Numbers 5 and 6. The new body, however, was somewhat longer.

In addition, the windshield was set back from the front a few inches (mm) to enable the windshield halves to be angled from the centre of the body towards the sides. (Photographs in Corness Collection) When complete, the body was designed to accommodate 27 seated passengers. (Letter to the City Commissioners from Waterous Ltd., May 18, 1940) The unit was painted in the standard SRD colors and was lettered "7".

The SRD required Number 7 immediately so it was imperative that the bus reach Edmonton quickly. The railroads were extremely busy because of the movement of war equipment and materiel so another method of transporting this bus to Edmonton had to be found. The City Commissioners decided to send Superintendent Allbright of the Civic Garage to Toronto where the bus was being assembled. When the bus was completed to his satisfaction, Allbright would accompany it by rail or ship to Fort William, Ontario (now Thunder Bay) where it would be off-loaded and driven to Edmonton. (Letter to the City Commissioners from Civic Garage Superintendent A. W. Allbright, October 23, 1940)

When Allbright reached Toronto on September 21, he discovered that Leyland had not modified the front suspension on that bus to reduce the front axle bounce. After the necessary modifications were made and the bus was completed, the unit was sent by rail to Fort William where Allbright received it and drove it to Edmonton, a trip which took six days to complete. Diesel fuel for the bus had to be obtained from specific bulk dealers along the route since diesel fuel was not readily available at that time. Although bus Number 7 arrived in Edmonton sooner than it would have had it been shipped by rail, it arrived partially damaged because of a slight mishap in transit. The damage, however, was quickly repaired once the unit reached Edmonton. (Letter to the City Commissioners from Civic Garage Superintendent A. W. Allbright, October 23, 1940) This method of bus delivery was considered extremely successful. Wartime conditions prevented the SRD from receiving further motorbuses in this fashion until after the Second World War.

New Equipment, 1941

The SRD was still suffering the effects of rolling stock shortages. Three Leyland trolley buses that had been ordered in November 1939 had been delayed in manufacture and shipment by the Second World War. Ridership on the SRD had been increasing, however. In order to alleviate some of the rolling stock shortage, the City Commissioners ordered two more diesel engine buses from the Toronto office of Leyland Motors in February. (Letter to Commissioner R. J. Gibb from Leyland Motors Ltd., February 27, 1941) Leyland was able to readily supply some units since they had several chassis left in stock. The chassis were larger than either the "cub" or "lioness" chassis that had been obtained by the SRD in the past. The new chassis, which were designated LTS.8 "Tiger", were each designed to support a 30 passenger body. (Letter to Commissioner R. J. Gibb from Leyland Motors Ltd., February 27, 1941) In addition to being longer than other Leyland buses in the SRD's fleet, the chassis were equipped with air operated drum brakes which were similar to the brakes supplied with bus Number 4. (Leyland Motors Ltd. Quotation, September 8, 1941) In order to prevent the diesel fuel from becoming viscous during cold weather, the fuel tanks were designed so that a bypass exhaust pipe passed through them. The heat from the bypass pipe tended to keep the fuel warm so that it did not become viscous. (Canadian Transportation, March 1941, pp. 151-152)

Transit or City type bodies manufactured by Smith Brothers Motor Body Works were attached to each chassis. The bodies, which were similar in appearance to the body of bus Number 7, could seat 30 passengers and had been designed for a large order of similar buses that had recently been delivered to the TTC. In addition to openable sashes on each side, small unopenable oval-shaped windows were placed above each openable sash. These small windows, referred to as "standee windows", enabled standing passengers to see outside the bus easily, thus reducing the probability that standing passengers (standees) would miss their stops because they could not see them coming. The front and the rear doors were air operated single-width folding doors. The rear door was treadle operated. Tubular seats, external clearance lamps and left-hand rear view mirrors were included with these bodies. (Canadian Transportation, March 1941, pp. 151-152)

The paint scheme was modified slightly with this order. The orange band at the front of the body swept down in a curve on either side of the radiator. A decorative curved shape in ivory paint was also applied to either side of the body. In addition, all molding strips, including those in the ivory areas, were painted black. (Color Photograph by H. Hollingworth) The buses were numbered 8 and 9, with a single number being placed in gold on the centre of the front of each bus between the bottom of the windshield and the top of the radiator grill. Plate 36 (Stan Diachuk) shows the appearance of bus Number 9 at the Civic Garage compound sometime during the Second World War. The standee windows, windshield wipers, side mirror, clearance lamps, horn and crankshaft should all be noted. Buses Numbers 8 and 9 both arrived in Edmonton by rail during March 1941. (SRDMR, March-April 1941, and Edmonton Journal, March 13, 1941, p. 13)

The three additional trolley buses did not arrive during the summer of 1941 so the SRD remained short of rolling stock. In early September, Plate 36. (Stan Diachuk) Bus Number 9 at Civic Garage

Plate 37. (Provincial Archives of Alberta) Buses at Strathcona Garage in February 1958

the City Commissioners asked Leyland Motors for a quotation on two additional "Tiger" buses similar to Numbers 8 and 9. At that time, Leyland's stock consisted of only two such units. (Letter to Commissioner R. J. Gibb from Leyland Motors Ltd., September 8, 1941) It was no longer a simple procedure for the City to purchase a motorbus. Wartime conditions had made it necessary for the Federal Government to restrict the amount of diesel fuel used by individuals and by municipalities. In order to be able to operate additional diesel buses, the City had to obtain an increase in their allocation of diesel fuel from the Oil Controller of the Department of Munitions and Supply. (Letter to Oil Controller from City Comptroller A. A. Campbell, September 11, 1941) The City Commissioners also decided that only one additional diesel bus would be necessary. (Letter to Leyland Motors Ltd. from the City Commissioners, September 1, 1941) The oil controller authorized the City to obtain the bus and the necessary quantities of diesel fuel to operate the bus. (Letter to Commissioner R. J. Gibb from Oil Controller, September 26, 1941)

The single Leyland bus, numbered "10", was practically identical to buses Numbers 8 and 9. (Photographs in Corness Collection) Number 10 was slightly heavier than Numbers 8 or 9 because it possessed larger tires. (Leyland Motors Ltd. Quotation for Vehicles, September 8, 1941) Number 10 was sent to Edmonton by rail and arrived during December. (Civic Garage Chart of Details and Costs for Street Railway Buses, 1943)

Equipment Modifications, 1942

The SRD and the City Commissioners had both received complaints from citizens about the sooty smoke which was exhausted from the diesel buses. The exhaust pipes, it should be recalled, were placed so that the exhaust escaped immediately below the bus body near the rear wheels. Besides causing some respiratory problems, the smoke tended to soil clothing, prompting some citizens to send their cleaning bills to the City. By late 1941, at least one alderman was enquiring about what could be done to eliminate the problem. Several attempts were made by the Civic Garage personnel to add volatile fluids to the diesel fuel in the hope that the fuel would be fully combusted. These attempts did little to reduce the smoke. In consultation with Leyland Motors, the Civic Garage crews extended the exhaust pipe of some of the diesel units so that it travelled up the rear of the bus body to the roof. (Letter to Alderman S. Parsons from Commissioner R. J. Gibb, December 2, 1941) Each exhaust pipe was placed along the centre of the bus at the rear, between the two windows, and was enclosed by a sheet steel cover which was riveted to the body. (Author's Inspection and Photographs of Bus Number 5)

This modification was disastrous. Although placing the tail pipe at roof level distributed the exhaust well above street level, the increased length of the pipe allowed soot to accumulate in it when the bus motor was idling. When the bus began to move again, the accumulated soot was expelled. The soot would then settle on the roof of the bus, giving the unit a filthy appearance; or the soot would settle onto adjacent pedestrians. Instead of improving the situation, the vertical exhaust made it worse. These vertical exhaust pipes were subsequently removed and the tail pipe was arranged so that the exhaust was expelled towards the centre of the street rather than towards the curb. (Letter to the City Commissioners from ETS Superintendent D. L. MacDonald, December 6, 1966)

New Equipment, 1943-1945

Up to this point in SRD bus operations, motorbuses were purchased in which part of the bus construction was fabricated to the SRD's specifications. While the chassis were usually "stock" items, the bodies, engines and the ancillary apparatus were usually selected by or were designed by the SRD. The Second World War and the low costs of assembly line production were to curtail severely the custom fabrication of motorbuses.

By 1943, the diesel engines in buses Numbers 1 and 3 were beginning to fail frequently. Heavy use and the unavailability of suitable repair parts contributed to this condition. The SRD, therefore, wished to obtain replacement units as soon as possible. The prevalent wartime conditions meant that motorbuses were not readily available. Most large plants and factories had been converted to war production work. In addition, off-shore suppliers such as Leyland could neither manufacture nor ship units to North America. In both Canada and the United States Federal authorities were established to allocate the few motorbuses that were being produced by selected companies. (Ford Motor Co. Report on Wartime Transit Buses, 1946)

In August 1943, the City Commissioners wrote to the Canadian Transit Controller requesting three or four motorbuses to replace buses Numbers 1 and 3 and to augment the bus fleet. (Letter to Transit Controller G. S. Gray from Commissioner R. J. Gibb, August 18, 1943) The Transit Controller allocated three Ford 27 passenger motorbuses to Edmonton, with delivery to be in late 1943. (Letter to Commissioner R. J. Gibb from Transit Controller G. S. Gray, August 20, 1943) This type of bus was allocated because there were no motorbuses being produced in Canada at that time and because the American War Production Board had allowed the Ford Motor Company to manufacture and export a number of buses of a particular type. (Ford Motor Co. Report on Wartime Transit Buses, 1946)

The Ford buses were all identical and were manufactured by the assembly line process in two Ford factories: one in Michigan, the other in Indiana. The chassis and the engines were fabricated and assembled in the Dearborn, Michigan plant. (Ford Motor Co. Photograph 74697 and Description) The chassis were then driven to the Ford body factory at Union City, Indiana where the bodies were fabricated and attached to the chassis. When completed, the buses were sent by rail to their ultimate destination. (Ford Motor Co. Report on Wartime Transit Buses, 1946. and Photograph 78361-14 and Description)

The chassis, which were fabricated of steel members, were arc welded together. A single 100 H.P. (74.6 kW) Ford V-8 gasoline engine supplied power to the rear axle. The motor was mounted transversely at the extreme rear of the chassis, with the radiator placed on the left-hand side. Spark advance was fully automatic, a combination of centrifugal and vacuum. Manual spark advance, therefore, was no longer required. The transmission contained helical gears and synchromesh devices for all three forward gears. Spur gears were used for the single reverse gear. Through a set of helical bevel gears, power from the transmission was transmitted at a right angle to a short driveshaft which was connected to a hypoid bevel gear differential on the rear axle. Long control rods connected the accelerator, clutch and the brake pedals to the respective apparatus. The engine also powered a 12 volt generator in addition to a small two cylinder air compressor. (Ford Motor Co. Specifications of Transit Type Rear Engine Bus, 1942) The placement of the engine at the rear of the bus reduced the length of the driveshaft as well as reducing the amount of fuel fumes that entered the body of the bus. Air operated drum brakes, shock absorbers, speedometer, fuel gauge, air pressure gauge, ammeter, engine coolant temperature gauge, driveshaft hand brake, electric horns, headlights and a single 12 volt battery were all supplied with each chassis. (Ford Motor Co. Specifications of Transit Type Rear Engine Bus, 1942)

A transit type body was attached to each chassis. The appearance and the construction of the bodies were similar to the bodies of buses Numbers 5 and 6. (Photographs in Author's Collection) The front door, however, was placed in front of the front wheels. This was possible since the engine was at the rear of the bus and it no longer obstructed the front area of the bus. No grill appeared on the front of these buses but a small ventilator was placed above the left-hand headlight. In addition, two small louvers were placed above the windshield to either side of the roller sign housing. The ventilator and the louvers could be opened during warm weather to allow air to flow through the interior of the bus. Arc welding was primarily used to assemble the body framing and to attach the body frame to the chassis. Wooden carlines were used to support the steel roof panels. The use of wood not only saved vital materials but it also absorbed some of the vibration when the bus was in operation. Aluminum foil insulation was placed between the roof and the ceiling as well as between the interior wainscoating and the exterior sheathing. The folding entrance and exit doors were on the right-hand side of the bodies and were air operated. The exit door could not be treadle operated because treadle units were not available at that time. A manually operated emergency exit was provided on the left-hand side near the centre of the body. (Ford Motor Co. Specifications, 1942, and Letter to Commissioner R. J. Gibb from Transit Controller

G. S. Gray, October 19, 1943) The seating of these buses was arranged to accommodate 27 passengers. Each bus was also equipped with: two combination tail and stop lamps, corner clearance lamps, front illuminated roller sign, interior lighting, engine compartment light, buzzer system, steel stanchions and grab handles, air operated two-blade windshield wiper over the driver's half of the windshield, interior and exterior mirrors, and two interior defroster fans located near each windshield section. (Ford Motor Co. Specifications, 1942) The complete buses were referred to as 29-B "Victory" models. (Civic Garage Chart of Details and Costs for Street Railway Buses, 1946)

It would first appear that the Ford buses represented a regression in motorbus construction because of the liberal use of steel and wood in the construction. The use of aluminum in motorbuses was curtailed during the War because it was a restricted metal, for use in fabricating military aircraft. (Ford Motor Co. Report on Wartime Transit Buses, 1946)

Heaters were not supplied with these buses but heaters were installed when the buses arrived in Edmonton. (Letter to Commissioner R. J. Gibb from Transit Controller, October 19, 1943) It is not known whether the three Ford buses ordered during 1943 were painted in SRD colors before being sent to Edmonton. The color scheme that was applied, however, dispensed with the orange band and the black borders and lines. (Photographs by E. M. Smith) The three buses were numbered 11, 12 and 13. The numbers in gold were applied to the front of the bodies in the centre. In addition, the number was also placed below the operator's window on the left-hand side, below the first window on the right-hand side and beneath the centre of the rear windows. (Photographs in Author's Collection) Buses 11, 12 and 13 arrived in Edmonton during

November and December. (Civic Garage Chart of Details of Costs for Street Railway Buses, 1943)

In early 1944, the City Commissioners queried the Transit Controller as to whether any diesel powered buses would be available since diesel engines usually required less maintenance than most gasoline engines. The Commissioners were informed that the City could purchase either additional Ford buses or similar GMC units, both powered by gasoline engines. (Letter to Commissioner R. J. Gibb from Transit Controller G. S. Gray, January 25, 1944)

The City decided to order three additional Ford units which were identical to the three already received. (Letter to Commissioner R. J. Gibb from Transit Controller G. S. Gray, April 11, 1944) Labor difficulties at Ford's body plant in Union City delayed the delivery of the buses. (Letter to Commissioner R. J. Gibb from Transit Controller G. S. Gray, November 30, 1944) Two buses arrived in December, while the third arrived in January 1945. The buses were numbered 14, 15 and 16. (Civic Garage Chart of Details and Costs for Street Railway Buses, 1946, see also Appendix I)

Equipment Disposal, 1944

The diesel engines installed in buses Numbers 1 and 3 had become extremely unreliable by 1944. Heavy use combined with the difficulty of obtaining parts from England and Germany contributed to the rapid demise of these diesel engines. By the end of July, the SRD decided that buses Numbers 1 and 3 were no longer fit for regular service. The buses were sold as complete operating units to a local mining company. (Letter to Transit Controller G. S. Gray from Commissioner R. J. Gibb, August 22, 1944)

New Equipment, 1946

Following the end of the Second World War in 1945, motorbus manufacturers could resume the production of motorbuses. On September 30, 1945, the Federal Government revoked the power of the Transit Controller, enabling transit operators to obtain motorbuses and trolley buses without consulting the Transit Controller. (Letter to Commissioner R. J. Gibb from Transit Controller G. S. Gray, September 13, 1945)

By August, the Canadian Car and Foundry Company announced that it was preparing to produce a modern city-type motorbus at their factory in Fort William (Thunder Bay), Ontario. The bus was designed by ACF-Brill Motors (formerly the J. G. Brill Company) of Philadelphia, Pennsylvania and was manufactured in Canada under license from that firm. (Canadian Transportation, August 1945, p. 453)

The SRD wished to continue its expansion of bus service (in addition to the gradual replacement of its streetcars with buses) so the Commissioners endeavoured to determine the cost, seating capacity and the delivery time of this type of motorbus. The buses were of a new design: the chassis was eliminated as a separate unit, and the motor was mounted beneath the centre of the bus, thus increasing the available space within the body. The seating capacity of these buses was to be 36 passengers, a greater seating capacity than any previous SRD motorbus. Any buses that Edmonton ordered, however, would not be fabricated until the latter part of 1946 because the Canadian Car and Foundry Company already had orders for 300 such buses. (Memorandum to SRD Superintendent T. Ferrier from Commissioner R. J. Gibb, September 27, 1945)

In December, the Commissioners placed an order for 12 of the 36 passenger buses for delivery by the end of 1946. (Letter to Canadian

Car and Foundry from Commissioner R. J. Gibb, December 1945) An additional seven buses were ordered during February 1946. (Letter to Commissioner R. J. Gibb from Canadian Car and Foundry Co., March 5, 1946)

The buses were designated model C-36. The "C" stood for city body or city service and the "36" referred to the seating capacity. (Canadian Transportation, August 1945, p. 453) A large separate steel chassis was not provided with these buses. An integral frame comprised the bus substructure. Steel channel sections and "I" beams were used for load-bearing portions of the underframe and the corner posts. All steel parts were riveted together. The framing which held the floor, sides and roof consisted of extruded aluminum alloy shapes which were riveted together with aluminum alloy rivets. The design of the substructure was such that the bus frame could not be moved under its own power without the body framing. (Canadian Car and Foundry Co. Specifications of Model C-36 Brill City Coach, 1949, p. 3) This type of unitized construction reduced the amount of material required for the bus substructure. The use of aluminum, which had been curtailed because of the Second World War, further reduced the total weight of the bus. It should be noted that this type of unitized, mass production construction had been developed during the War through the production of many types of Allied military aircraft. The C-36 motorbus represented a transferral of this technology from military uses to civilian purposes. (Canadian Transportation, August 1945, pp. 453-454)

The flooring consisted of 5/8 inch (16 mm) thick water-proof plywood which was covered with linoleum and with ribbed rubber matting in the aisle areas. Unlike the hardwood tongue and groove boards used previously, plywood was easy to install and it improved passenger safety because of its fire-resistant properties. (Canadian Car and Foundry Co. Specifications, 1949, p. 3) Plywood was usually inexpensive compared to hardwood flooring. Two-step stairwells were provided for a single-width front door and for a treadle-operated centre exit door. The step risers were fabricated of welded steel plates. The front door step treads were made of water-proof plywood, while each of the centre door step treads consisted of a treadle. The doors were fabricated of plywood and were designed to fold when opened. Air operated cylinders controlled both the front and the centre doors. A single emergency exit swing door was provided in the centre of the left-hand side. Each side contained several windows which had extruded aluminum sashes. The windows were designed so that only the lower two-thirds of each sash could be opened. In this arrangement, the part of the sash nearest the front of the bus could be slid behind the other half of the sash, thereby allowing air to enter the interior. This arrangement prevented passengers from easily sticking their arms out of the windows. In addition, it prevented a blast of air from striking the passengers sitting behind the open window. The large height of the windows enabled standees to see outside. The rear window as well as the windshield was in two halves. Each windshield half was sloped inwards 24° in order to reduce glare. A single air operated windshield wiper was provided at the bottom of each windshield section. Safety glass was used for all windows except for the small oval-shaped windows in the front and centre doors. (Canadian Transportation, August 1945, pp. 453-454)

Sheet aluminum and some sheet steel was used for all interior panelling above the bottoms of the window sashes, while masonite was used for the wainscoating. The exterior sheathing, including the roof, consisted of sheet aluminum which was riveted to the substructure members with aluminum alloy rivets. A fireproof insulating material 1½ inches (38 mm) thick was placed between the interior and the exterior panelling. An extruded aluminum rub rail was placed along the exterior panels below the windows. The rub rail was designed to protect the panels below the windows from minor blows and sideswipes. (Canadian Car and Foundry Co. Specifications of Model C-36 Brill City Coach, 1949, pp. 3-4)

The interior seating, which consisted of tubular seats covered with a green synthetic covering which resembled leather, also included four longitudinal seats. The interior lighting, which was arranged in a similar manner to the lighting used on other ETS buses, employed fixtures which had convex lenses that tended to spread the light from each fixture over a wide area. Aluminum stanchions and grab rails were provided with each bus. Exterior lighting included all the items described in previous sections. These buses also came equipped with flashing directional signal lamps. These lamps were placed at the rear of the bus as well as at the front. The lamps were clustered with the stop and the tail lamps at the rear; they were clustered with the parking lamps at the front. Red colored lenses covered the rear clusters, while amber lenses were used to cover the front clusters. (Canadian Car and Foundry Co. Specifications, 1949, p. 4) These buses were the first units in ETS service which possessed any form of electric directional signal. In earlier motorbuses, the operator had to stick his arm out of his window in order to inform motorists that the bus was about to make a turn.

The C-36 buses were powered by a Hall-Scott six cylinder inline gasoline engine which was located beneath the floor of the bus near the left-hand side. A hinged cover on the side of the body facilitated access to the engine. A manual transmission with three forward gears as well as a hydraulically operated single-plate clutch were also provided.

The transmission was manufactured by the Spicer Manufacturing Corporation of Toledo, Ohio. (Canadian Car and Foundry Co. Specifications, 1949, p. 10) A short driveshaft connected the transmission to a hypoid bevel gear differential on the rear axle. The placement of the engine beneath the floor of the bus near the centre enabled the weight of the engine to be more evenly distributed over the front and the rear axles than on buses with rear or front mounted engines. A 75 imperial gallon (341 L) gasoline tank was also located beneath the floor, but at the rear of the bus. An electric fuel pump was used to move the gasoline from the tank to the carburetor. (Canadian Car and Foundry Co. Specifications, 1949, p. 9) Air operated drum brakes were supplied on all four wheels in addition to a driveshaft hand brake. Both the front and rear axles were supported by leaf springs and shock absorbers. The charging system consisted of a 100 Ampere, three-phase alternator and rectifier assembly which was driven by the engine through a double V-belt arrangement. (Canadian Car and Foundry Co. Specifications, 1949, p. 8) An alternator was more efficient at producing a sufficient charging voltage at low engine speeds than a generator.

The buses were painted in a similar manner to the wartime Ford buses. These buses also had several decalcomania monograms applied to them. The monograms consisted of the letters "ETS" in yellow, surrounded by a black oval. (Letter to Canadian Car and Foundry Co. from D. L. MacDonald, February 2, 1948) The decals were applied to the front of each bus as well as to the right-hand and left-hand sides near the front. These buses were the first vehicles since buses Numbers 1 through 3 which displayed any external identification lettering. The C-36 buses were numbered 17 through 35. (See Appendix I) Following painting and lettering, the buses were sent to Edmonton by rail. (Telegrams to the ETS from Canadian Car and Foundry Co.) Plate 37 (Provincial Archives of Alberta) shows the appearance of bus Number 33 in February 1958. The decalcomania monograms should be noted. It should also be realized that the storm sashes on the side windows were obtained after the buses had been in service for some time.

In 1946, the large increase in the bus fleet induced the ETS to construct a bus garage and maintenance facility on the west side of the Cromdale car barns. When the new garage was opened, the services of the Civic Garage were dispensed with. Some of the Civic Garage personnel, however, were transferred to the ETS so that they could continue to service the City buses. (ETSAR, 1946, pp. 1-2)

Leased Equipment, 1946-1947

Prior to the arrival of the C-36 buses, the ETS leased an additional Ford bus from the firm of McMullen and Noullett. The arrival of the new buses in December 1946 meant that the services of the leased bus were no longer required. The lease, therefore, was cancelled in February 1947. (Letter to the City Commissioners from the City Solicitor, February 12, 1947)

Equipment Modifications, 1947

The major disadvantage of obtaining a large number of identical buses from one firm was that if a particular problem developed on one unit, it was likely that the problem would appear on all other similar units. Three serious problems developed in the new C-36 buses. In cold weather the ETS, as well as other bus operators of this particular type of bus, found that the temperature of the engine coolant remained low, which severely limited the amount of heat that could be used to heat the interiors of the buses. To alleviate this problem, the Canadian Car and Foundry Company recommended blocking the air intake for the radiator and the installation of a thermostat on the upper hose of each radiator. (Letter to ETS Superintendent T. Ferrier from Canadian Car and Foundry Co., December 11, 1946) Although these measures increased the temperature of the engine coolant slightly, the temperature was still too cold. In an attempt to minimize heat loss from the interior of the buses, the ETS ordered wooden-framed storm sashes for the side windows of each C-36 unit. (Letter to Canadian Car and Foundry Co. from D. L. MacDonald, December 24, 1946) The storm sashes did reduce heat loss but they did little to increase the engine temperature.

During 1947, Canadian Car and Foundry recommended that each engine be equipped with an underpan assembly which would enclose the engine, thereby reducing the air flow around the block. This measure was successful in eliminating the low engine temperature problem and the ETS eventually installed the underpan assembly on all its C-36 units. (Letters to Canadian Car and Foundry Co. from D. L. MacDonald, June 24, and December 23, 1947)

Another problem caused by cold weather was moisture in the air supply condensing and freezing in the door apparatus and in the air brake cylinders. The ETS solved this problem by installing alcohol evaporators in the air system. (Letter to Canadian Car and Foundry Co. from ETS Assistant Superintendent D. L. MacDonald, October 28, 1948) An alcohol evaporator was a device which mixed methyl alcohol vapors with the compressed air, thereby preventing the suspended moisture in the air from freezing in the system when it condensed.

A far more serious problem became apparent in 1947. Some of the Hall-Scott engines began to suffer catastrophic damage as the result of piston collapse. The pistons, which were an aluminum alloy, were designed for use with high octane gasoline that would burn rapidly in the cylinders. (Canadian Transportation, August 1945, p. 454) The high octane gasoline recommended for these engines was not readily available, and the slow and uneven burning of the lower octane gasoline caused some of the pistons to deform. If the deformity was severe, the piston could push a hole through the cylinder liner, the engine block, or both. (Letter to Canadian Car and Foundry from D. L. MacDonald, June 24, 1947) The Hall-Scott Company, who manufactured the engines, solved the problem of piston collapse, by providing new substitute pistons which were heavier than the original pistons. In addition, Hall-Scott manufactured a modified cylinder head which was designed for use with low octane galoline. (Letter to Canadian Car and Foundry from D. L. MacDonald, September 2, 1947) The piston and the cylinder head replacement program took place gradually, as each bus underwent a major overhaul.

The directional lamps on the C-36 buses proved to be such a popular and effective feature, that the ETS decided to install the same type of directional lamps, and the clustered indicator lamps on most of the buses in the fleet. (Letter to Canadian Car and Foundry Co. from D. L. MacDonald, March 3, 1947, and Photographs in Corness Collection)

Equipment Disposal, 1947

The arrival of the new C-36 buses enabled the ETS to retire some of their older equipment. Bus Number 2, which had been in service since 1932, was retired at the end of May. (ETSMR, May-June, 1947) In addition to requiring extensive repairs and rebuilding, the configuration of the body was no longer appropriate for ETS operations. Bus Number 4 was also retired. (ETSMR, August-September, 1947) The unit in addition to having an obsolete body had become expensive to operate because of its heavy fuel consumption. (Letter to Librarian H. C. Gourlay from Mayor H. D. Ainlay, January 10, 1946) Bus Number 4 was sold to the Edmonton Public Library where it was outfitted as a "bookmobile". (Letter to the City Commissioners from the City Comptroller, October 21, 1948) The bookmobile operated in a similar fashion to the Library streetcar. (Photographs in Corness Collection)

New Equipment, 1948-June 1950

Between December 1947 and January 1950, the ETS ordered 18 additional C-36 motorbuses. (Letters to Canadian Car and Foundry Co. from D. L. MacDonald, December 8, 1947, September 8, 1948, and Letter to ETS Superintendent T. Ferrier from Canadian Car and Foundry Co., January 31, 1950; see also Appendix I) These units, numbered 36 to 53, were practically identical to the C-36 buses received earlier. In addition to the necessary engine modifications, the buses came equipped with: storm sashes, alcohol evaporators, brake interlocks for both the front and centre doors, sheet metal partitions to isolate the operator's area, an exterior plug to enable the battery to be charged without removing it from the bus, and dust shields for the brake drums. (Letter to the Canadian Car and Foundry Co. from D. L. MacDonald, December 8, 1947)

Canadian Car and Foundry also provided lift sashes instead of the older half-sliding type. (Photographs in Author's Collection) A major mechanical change was also introduced. The old system of rods and levers used to connect the operator's pedals to the engine, clutch and brakes was abandoned in favor of sheathed flexible steel cables. (Letter to Canadian Car and Foundry Co. from ETS Assistant Superintentent

D. L. MacDonald, October 28, 1948) The steel cables were supposed to enable the pedals to be depressed easily by the operator's feet. In addition, fewer parts were required with the flexible cables than were required with the older hydraulic system used for the clutch. Problems were encountered with the first units equipped with control cables because the grease they were packed with tended to freeze in low temperatures. The use of a low temperature grease solved most of the problems with the sheathed cables. (Letter to Canadian Car and Foundry Co. from ETS Assistant Superintendent D. L. MacDonald, January 19, 1949)

By the late 1940's, other bus manufacturers were producing modern motorbuses for the Canadian market. One such company was Twin Coach of Kent, Ohio. That company had a branch plant in Fort Erie, Ontario where some bus models were assembled. By assembling the buses in Canada, the company avoided paying import duties. One model that was assembled in Canada was the 44-S gasoline powered bus. (Letter to the City Commissioners from ETS Superintendent T. Ferrier, January 19, 1950) This type of bus was similar in construction and in basic appearance to the C-36 bus; but the 44-S bus possessed steel frame members rather than aluminum. The frame and the body of the 44-S was longer than the body of a C-36 bus. The 44-S unit could seat 44 passengers. (Twin Coach Maintenance Manual, 1950) The front end of the Twin Coach buses was somewhat different in appearance from the C-36 units. The windshields of the Twin Coach buses contained a lower portion which was angled so that the operator could see the road directly in front of the bus. In addition, decorative louvers were installed on either side of the front roller sign. The two-piece entrance and exit doors were supported on special lever hinges which permitted the doors to rotate as they opened. In this manner, grab handles on the inside of the doors were made available for the passengers. (See Bus Number 82 in Plate 37)

The 44-S bus was powered by an FTC model 180 six cylinder inline engine which was manufactured by the Fageol division of Twin Coach in Kent, Ohio. The "FTC" stood for Fageol Twin Coach. The 44-S bus was also equipped with a hydraulic torque converter (a type of automatic transmission) supplied by the Spicer Manufacturing Corporation. (Twin Coach Maintenance Manuals, 1950) In addition to leaf springs, the front and rear axles were supported by large steel torsion bars which were designed to provide a smooth ride without a large number of moving parts. (Letter to P. W. Hawtin from ETS Supervisor of Maintenance S. P. Derbyshire, April 12, 1951)

The ETS ordered six model 44-S buses in early 1950. (Letter to the City Commissioners from ETS Superintendent T. Ferrier, January 19, 1950) These units were painted in a similar manner to the C-36 buses. The 44-S buses, however, were equipped with wide fluted aluminum rub rails which were polished, not painted. Three of these units, numbered 54 through 56, were driven to Edmonton from Fort Erie, Ontario by ETS employees in June 1950. (ETSMR, May-June 1950, and Edmonton Journal, June 17, 1950, p. 26) These buses were driven to Edmonton for two reasons. Firstly, it was cheaper to drive the buses to Edmonton than to transport them by rail. Secondly, by sending their maintenance employees to the factories at Kent, Ohio and at Fort Erie, Ontario in order to take special maintenance courses, the ETS could ensure that proper maintenance procedures would be followed with these units. (Letter to the City Comptroller from Commissioner D. Menzies, May 16, 1950) The remaining three units, numbered 57 through 59, were ready for delivery by the end of July. (Memorandum to City Comptroller from

Commissioner J. Hodgson, June 27, 1950)

Equipment Modifications, 1949

By mid 1948, the diesel engines on Leyland buses 5 through 10 were beginning to require expensive repairs and frequent maintenance. In addition, many citizens had complained about the odor of the diesel fumes as well as the excessive noise produced by the diesel engines. Taking these points into consideration, the ETS decided to replace the diesel engines on these buses with new gasoline engines. (Letter to International Transit Ltd. from D. L. MacDonald, April 29, 1948) New diesel engines were not considered because the ETS believed that such engines: adversely affected the riding qualities of the buses; had stronger exhaust odors than gasoline buses; were much heavier than gasoline engines. (Letter to the City Commissioners from ETS Superintendent T. Ferrier, July 15, 1948)

In early 1949, the ETS purchased two Chrysler Industrial gasoline engines along with new radiators, clutches and five-speed manual transmissions. The engine was designated model Ind. 11 (T 124). Buses Numbers 7 and 10 were each fitted with one of the new radiators and engine assemblies. The cost of maintenance and operation of the new Chrysler engines was less than the cost of operating the older diesel engines in these units. (Letter to Canadian Car & Foundry Co. from ETS Assistant Superintendent D. L. MacDonald, June 30, 1949) The ETS were so satisfied with the performance of the new Chrysler engines that they replaced the engines in buses Numbers 5, 6, 8 and 9 by the end of 1949. (Letter to Canadian Car & Foundry Co. from ETS Assistant Superintendent D. L. MacDonald, June 30, 1949, and Report on Trolley and Motor Coach Requirements, April 1951, p. 1)

It should be noted that following the conversion of the Leyland buses from diesel to gasoline, the ETS no longer operated any diesel powered motorbuses. (See Appendix I) The conversion from diesel to gasoline was a reversal of the 1936 policy which had converted several gasoline powered buses to diesel operation. Although diesel fuel remained less expensive than gasoline, the offensive odor of the diesel exhaust combined with the high operating costs of diesel engines, convinced the ETS to abandon its use of diesel engines. (Letter to Canadian Car & Foundry Co. from ETS Assistant Superintendent D. L. MacDonald, June 30, 1949)

The ETS, however, was interested in other fuels besides gasoline. The discovery of large quantities of oil and gas in Central Alberta made available large amounts of Liquid Petroleum Gas (LPG) at low cost. LPG, which is commonly referred to as "propane", is a hydrocarbon which is a product of oil and gas refining. (MacDonald, 1950, p. 2) In addition to being plentiful in Alberta, propane was inexpensive compared to gasoline and diesel fuel. (MacDonald, p. 4)

In order to use propane as a fuel for motorbuses, a special storage tank and carburetor had to be installed on the bus. In December 1949, the ETS purchased a Parkhill-Wade Company propane tank and delivery unit and installed it on bus Number 14, one of the wartime Ford units. (Letter to Allsop & Co. from ETS Assistant Superintendent D. L. MacDonald, August 21, 1950) The propane system consisted of a cylindrical steel tank with semi-elliptical ends which was welded together. The tank, designed to withstand an internal pressure of 250 pounds per square inch (1 724 kPa), could hold approximately 75 imperial gallons (341 L) of LPG. In addition to a safety valve, the tank contained a filler valve and an outlet pipe coupling. (Parkhill-Wade Co. Specifications of Propane Delivery System, June 1950) In order for the LPG to be useable by the engine, it had to be converted back into its gaseous state. This was accomplished by passing the liquid propane through copper tubing, through a felt fuel filter to trap any suspended particles, to a regulator unit. The regulator unit, which consisted of two separate stages, served to reduce the pressure of the LPG as well as to gassify it. The liquid propane entered one end of the regulator where it encountered a diaphragm and spring controlled valve. The diaphragm was moved back and forth by the bus engine's oil pressure since the amount of propane required by the engine was determined by the engine's speed and load. If the engine was idling, oil pressure would be low and the diaphragm would not be moved. The regulator would allow only two pounds per square inch (14 kPa) of propane to pass through the first stage of the regulator. If the engine was under load, the oil pressure would be higher, so the diaphragm would open the valve and allow more propane to pass at a higher pressure. After passing through the first stage, the LPG was vaporized because of the drop in surrounding pressure. The propane gas then passed through a series of tubes within the regulator housing. These tubes were surrounded by circulating engine coolant. The coolant tended to heat the propane which vaporized any remaining LPG and also prevented the regulator unit from freezing as a result of the vaporization of the LPG.

The propane then entered the second stage of the regulator which consisted of a large chamber with a diaphragm-controlled exit valve. At this point in the travel of the propane from the storage tank to the carburetor, the pressure was reduced to a slight vacuum. (Parkhill-Wade Specifications, 1950)

The carburetor required for propane was similar in basic construction to a single barrel gasoline carburetor. Instead of containing a float and a float bowl, the propane carburetor contained a small pipe which was connected to the carburetor's venturi. As the venturi created a partial vacuum, the resulting suction was transmitted to the second stage diaphragm on the regulator by means of a tube. The suction would cause the diaphragm to open the valve which would permit the propane in the second stage chamber to reach the carburetor. In this manner, propane reached the carburetor of the engine. (Parkhill-Wade Co. Specifications, 1950)

The propane conversion of bus Number 14 appeared to be quite successful despite an initial apprehension about increased fire hazard with propane. An accidental fire in the engine compartment of bus Number 14 in early 1950, caused by a sticking regulator valve, showed that propane was safer than gasoline since the fire did not spread and was easily extinguished. (Letter to Allsop & Co. from ETS Assistant Superintendent D. L. MacDonald, August 21, 1950)

Propane had a higher octane value than the gasoline used by the ETS at that time so the engine tended to operate without "knocking". The propoane also reduced exhaust emissions and kept crankcase oil dilution to a minimum. Fuel consumption per mile (km) increased with the use of propane. This increased consumption was offset by the extremely low cost of the LPG. (MacDonald, 1950, p. 4) The success of the propane conversion of bus Number 14 encouraged the ETS to use propane with other buses.

In order to improve the visibility of the left-hand turn indicators on all motor and trolley buses, the ETS installed a small red clearance lamp beneath the driver's window on the left-hand side of each bus. The lamp was connected to the left-hand directional lamp circuit and was an inexpensive safety improvement. (Letter to B. C. Electric Railway Co. from ETS Assistant Superintendent D. L. MacDonald, November 21, 1949)

New Equipment, July 1950-April 1951

In the section describing new equipment obtained through June 1950, it was mentioned that three model 44-S Twin Coach buses, Numbers 57 through 59, were delivered during July. The successful use of LPG as a fuel for bus Number 14 prompted the ETS to have one of the new buses on order converted to LPG as well.

The conversion was undertaken by Twin Coach which had the Parkhill-Wade Company prepare a special conversion package for many post-war Twin Coach gasoline powered buses. (Twin Coach Propane Conversion Manual, March 1951) The bus selected for the conversion was Number 59. The apparatus was installed on the bus at the factory. (MacDonald, 1950, p. 1) Buses 57 through 59 were driven from Fort Erie, Ontario to Edmonton during July. (Memorandum to City Comptroller from Commissioner J. Hodgson, June 27, 1950)

The ETS required more buses by July and tenders were received for the supply of ten buses from the Canadian Car and Foundry Company and the Twin Coach Company. Both companies submitted tenders for trolley buses but Twin Coach also submitted a tender for the supply of propane powered motorbuses. Although the ETS had decided that the trolley bus was to be the mainstay of the fleet, Superintendent Ferrier recommended the purchase of ten propane buses instead of the trolley buses. In a letter to the Commissioners, Ferrier stated, "The motorbus becomes much more economical to operate with this fuel [LPG] and the difference in operating costs between trolley and motor coaches will, therefore, be reduced" (August 3, 1950). Ferrier also cited increased route flexibility as a reason to purchase propane units, "The present international situation requires one to consider the use of independent vehicles so that possible new industrial or military areas may be served" (August 3, 1950).

The City Commissioners followed Ferrier's recommendation and ten propane motorbuses were ordered from Twin Coach. It should be noted that these buses were each equipped with a larger engine, the FTC 210. (Letter to the City Commissioners from ETS Superintendent T. Ferrier, August 3, 1950)

The buses, designated as model 45-S, were externally identical to buses 54 through 59. The seating arrangement of the 45-S buses was designed to accommodate 45 passengers. (Letter to the City Commissioners from ETS Superintendent T. Ferrier, April 19, 1951) The buses were numbered 60 through 69. They were completed in Canada and ETS employees drove the units from Fort Erie to Edmonton, through the United States, during December. (Letter to Burdett Oxygen Co. from ETS Assistant Superintendent D. L. MacDonald, November 15, 1950) Although the ETS saved shipping costs by having the buses driven to Edmonton, five of the buses were involved in minor mishaps before they arrived in Edmonton. (ETS Accident Reports, December 15, 1950) These accidents encouraged the ETS to search for other methods of transporting new buses to Edmonton.

An additional thirteen 45-S buses were ordered from Twin Coach in December 1950 and were driven to Edmonton from Fort Erie during April 1951 by a private delivery firm. (Freight Bills from Howard Sober Driveaway Inc., April 1951) It was less expensive for the ETS to hire the delivery firm than it was to have its own personnel drive the buses to Edmonton. (Letter to Canadian Pacific Railway from ETS Superintendent T. Ferrier, February 28, 1951) In addition, the delivery firm undertook responsibility for any damage to the vehicles on their way to Edmonton from the factory. (Freight Bills from Howard Sober Driveaway Inc., April 1951) The buses, numbered 70 through 82, were identical in appearance to the earlier model 45-S Twin Coach buses in the ETS fleet. (See Appendix I) Plate 37 (Provincial Archives of Alberta) shows the front portion of bus Number 82 during February 1958. The design of the windshield should be compared with other buses visible in the plate.

Used Equipment, 1951

The older Leyland and Ford buses were beginning to show the effects of age and heavy wartime use by 1951. These buses had been used previously for peak hour service and were in need of frequent maintenance. (Letter to Canadian Car & Foundry Co. from ETS Assistant Superintendent D. L. MacDonald, April 17, 1951) In order to ease this situation, the ETS purchased eleven used C-36 buses from the defunct St. John, New Brunswick Power Company in April. (Contract between New Brunswick Power Co. and ETS, April 27, 1951) The buses, which had been manufactured during 1946, required new tires before they could be driven to Edmonton. A Red Deer, Alberta equipment broker, G. L. Sorensen and his firm, were hired to drive the buses to Edmonton. (Letter to Goodyear Tire & Rubber Co. from ETS Assistant Superintendent D. L. MacDonald, April 26, 1951, and Letter to D. L. MacDonald from G. L. Sorensen, May 8, 1951)

The eleven buses were repainted in Edmonton's colors and were numbered 83 through 93. (ETS Chart of Bus Licensing Details, 1953; See also Appendix I) These units resembled the other ETS C-36 buses.

(Photographs in Provincial Archives of Alberta)

Equipment Disposal, 1951

The purchase of the used C-36 buses enabled the ETS to retire some of the older Leyland and Ford buses. Increasing ridership, coupled with the removal of streetcar service, however, resulted in the ETS having a shortage of buses. The ETS, therefore, was able to retire only two of the older units. One of the Leyland buses, Number 6, was withdrawn from service and was sold to the Edmonton Public Library where it was outfitted as a bookmobile. (Forty Years of Public Service, 1951, p. 29)

The ETS also received a firm order for the purchase of their newest Ford bus. The bus, Number 16, was sold to a small interurban bus operator in British Columbia. (Letter to Canadian Trailway Stages from ETS Assistant Superintendent D. L. MacDonald, June 5, 1951, and ETS Chart of Bus Licensing Details, 1953)

New Equipment, May 1951-1952

The ETS planned to remove all streetcars from service by the end of 1951. In order to be able to accomplish this, additional motor and trolley buses were required in addition to those units already on order for 1951 delivery. The ETS received several tenders for motorbuses from different companies. The most favorable tender received was from Twin Coach which offered a 52 seat bus equipped with a propane powered FTC 210 engine. (ETS Report on 1951 Trolley and Motor Coach Requirements, March 1951, p. 1) In late April, the ETS recommended that twelve 52 seat Twin Coach buses be ordered. (Letter to the City Commissioners from ETS Superintendent T. Ferrier, April 19, 1951) The buses could not be assembled in Canada, however, because the Canadian Department of National Defense planned to take over the Fort Erie plant for aircraft production due to Canada's involvement in the Korean War. The cost of the new buses would, therefore, be greater because of import duties. (Letter to Commissioner D. B. Menzies from Twin Coach of Canada, April 11, 1951) The Korean War also delayed the production of the buses in Twin Coach's factory in Kent, Ohio.

By mid 1951, work on the buses had not been started and the ETS was proceeding with its plans to abandon streetcar service. In order to prevent a serious equipment shortage, the ETS placed an order with the Mack Manufacturing Corporation of Allentown, Pennsylvania for six motorbuses which could each accommodate 37 seated passengers. (Letter to the City Commissioners from ETS Superintendent T. Ferrier, December 17, 1951) These buses, model C-37DT, were similar in appearance to the Canadian Car and Foundry C-36 motorbuses. The framing of the Mack C-37DT bus, however, consisted entirely of high tensile steel members which were arc welded together. The engines on these buses were six cylinder diesel units which were mounted transversely at the rear of each bus. (Mack Specifications of Model C-37 Bus, pp. 15-20) Diesel engines were selected by the ETS since propane powered engines were unavailable from Mack and because significant improvements had been made in the design of diesel engines since 1941 when the last Leyland diesel buses were purchased. (Letter to the City Commissioners from ETS Superintendent T. Ferrier, December 17, 1951) These buses were also equipped with automatic transmissions. (Mack Bus Chassis Record for Order C 371D-48)

The heating system was also improved on these units. Instead of one or two hot water heaters located within the body, a system of circulating hot air kept the interior of the bus warm. Air intake vents were concealed directly above the windshield halves immediately below the roller sign. These vents were connected to ducts which were located between the ceiling and the roof of the bus. The ducts led to a heater compartment at the rear of the bus which was placed above the engine and was isolated from it. The air would pass through a large hot water heater unit in the compartment. An electric fan forced the heated air into two ducts which ran beneath the floor of the bus for its entire length. The pedestals holding the cross seats were designed so that they were connected to holes in the ducts. The sides of the pedestals were also perforated. In this manner, the heated air in the ducts entered the interior of the bus. Dampers within the duct system allowed cold air to be mixed with the heated air in order to moderate the temperature within the bus. Air cylinders controlled the action of the dampers. A wall-mounted thermostat located near the centre exit door controlled the operation of the dampers. In order to provide adequate air circulation, stale air within the bus had to escape. Two louvered vents located at the rear of the interior above the seats enabled the stale air in the interior to travel to the engine compartment. The air not only heated the engine compartment during cold weather, it also prevented diesel fumes from entering the bus interior because of the positive airflow out of the interior. (Mack Specifications of Model C-37 Bus, pp. 21-24)

The buses were painted in the standard ETS colors and were numbered 94 through 99. (Mack Photographs 1151C6208 and 1151C6209) The buses were driven to Edmonton by a delivery firm during November 1951. It should be noted that storm sashes were provided with these buses. (Mack Bus Chassis Record for Order C 371D-48)

The twelve 52 seat Twin Coach buses that had been ordered in April had failed to arrive by the end of 1951. In consequence, the ETS offered to cancel its order for the buses and to re-order them when the production of the buses could be resumed. (Letter to Twin Coach of Canada from ETS Superintendent T. Ferrier, December 27, 1951) The Twin Coach Company did overcome its production difficulties and the construction of the buses began in early 1952. The price of the buses, however, was to be considerably higher than anticipated so the ETS reduced their order from twelve to eight buses. The eight buses, numbered 401 through 408, arrived in Edmonton during May 1952. (ETS Chart of Bus Licensing Details, 1953) The numbers 401 through 408 were used because numbers 101 through 299 had been allocated for trolley buses; and numbers 301 through 399 had been allocated to ETS auxiliary vehicles such as inspectors' cars. (ETS Statement of Account 22205, 1959)

The buses, which were designated model FLP-40, were identical in appearance to the 45-S buses in the Edmonton fleet. The FLP-40 buses were somewhat longer, however, and could seat 52 passengers. (Photographs in Corness Collection; see also Appendix I)

Leased Equipment, 1952

The inordinate delay in the fabrication and delivery of the FLP-40 Twin Coach buses forced the ETS to lease equipment in order to maintain adequate service on some routes during peak hours. In December 1951, the ETS finalized an agreement with the British Columbia Electric Company of Vancouver for the lease of eight of their model 41-S Twin Coach buses starting in January 1952. The eight buses were to be transported to and from Edmonton by rail. The buses could be leased until April 1952. (Agreement between B. C. Electric Co. and ETS, December 15, 1951) These buses did arrive in Edmonton and were used in service. They were similar in appearance to the Twin Coach buses in Edmonton's fleet. (Photographs in Corness Collection) Appendix I lists some of the relevant information about these leased buses. The arrival of the eight FLP-40 Twin Coach buses in May 1952 eliminated the need for leased buses in 1952.

Equipment Modifications, 1952

In late 1952, the ETS installed two-way radios on a few of their propane-powered Twin Coach buses. The radios enabled inspectors to divert the buses from one route to another during peak hours as the ridership on the various routes increased or decreased. In this manner, the buses equipped with radios could be used to ease crowding on heavily-used routes. The use of the two-way radios was believed to be the first such installation on any Canadian municipal transit system. (Edmonton Journal, December 19, 1952, p. 1) The use of the two-way radios was not continued. It was not until the late 1970's that such equipment was installed on all ETS vehicles. (Author's Observations)

Equipment Modifications, 1954

It was inevitable that each bus would suffer damage to some of its body panels at some point in its service on the ETS. In the past, replacement panels were fabricated from sheet aluminum. It was difficult and expensive to form replacement panels for curved sections out of aluminum, however. In an attempt to reduce body repair costs, the ETS introduced the use of fibreglass reinforced resin panels in early 1954. If, for example, a curved rear panel on a bus was damaged beyond repair, a wooden mold was made of the correct shape of the panel. Layers of fibreglass cloth would then be spread over the mold and would be saturated with a polyester resin mixed with a catalyst. The catalyst would cause the resin to harden. The fibreglass cloth provided strength to the hardened resin. When fully cured, the fibreglass panel was removed from the mold. The panel was then trimmed and was installed on the bus with either rivets or self-tapping screws. After it was painted, the fibreglass panel was indistinguishable from the aluminum or the steel panels it replaced. (Edmonton Journal, October 18, 1954, p. 21)

The fibreglass panels had the additional advantage of being resistant to corrosion and to denting. Fibreglass panels were not normally used for the replacement of flat panels since it was cheaper to use sheet aluminum as the replacement. Fibreglass was used, however, to repair and to replace corrosion damaged parts of wheel wells and step wells. The use of fibreglass as a body repair material for buses was innovative since it was believed the method had not been used elsewhere in Canada at that time. The ETS adopted the idea of using fibreglass from several automobile manufacturers who had been fabricating sports car bodies from fibreglass. (Edmonton Journal, October 18, 1954, p. 21) Fibreglass continues to be used as a repair material for the buses in the fleet of ET. (Author's Observations)

Equipment Disposal, 1954

Stable ridership levels, combined with the arrival of additional trolley buses, enabled the ETS to retire the remainder of its Leyland and Ford buses. (CECR No. 24, August 9, 1954) It is of interest to note that while most of these buses were sold, bus Number 5 was converted for civil defense purposes and was stored in the Cromdale car barns. (Author's Observations and Photographs)

New Equipment, 1955-1958

A gradual increase in ridership enabled the ETS to order ten new motorbuses during 1955. The buses were ordered from the Truck and Coach division of the General Motors Corporation and were driven to Edmonton from GM's Pontiac, Michigan factory by a delivery firm in September 1955. (ETS Listing of Buses, 1956, and Letter to the City Commissioners from ETS Superintendent D. L. MacDonald, July 20, 1962)

The buses were model TDH-5105. (ETS Listing of Buses, 1956) The "TDH" stood for Transit (body type), Diesel Hydraulic (engine fuel and transmission type). (GMC Operating Manual, 1961) The buses resembled the six Mack C-37DT buses that had been obtained during 1951. The TDH-5105 buses, however, were longer and could nominally seat 51 passengers although the seating arrangement on the ETS buses enabled 52 passengers to be seated. (ETS Specifications of Buses, 1960) The conventional leaf spring suspension system was also absent on these buses. In 1953, GMC began to equip its transit bus models with a type of front and rear axle suspension which employed a system of nylon reinforced rubber bellows which were inflated with compressed air. The bellows arrangement was designed to flexibly support the bus above the axles. (Canadian Transportation, November 1953, p. 651)

The air suspension system, as it was referred to, was simple in design and provided a smoother ride than vehicles equipped with leaf springs. In addition to the necessary support beams and channels, the underside of the bus above each axle contained two parallel lengths of hollow steel square stock which were placed near each side of the bus. Each section of square stock had both ends sealed in order to provide an air chamber inside. Each axle held two steel supports, each of which held two bellows by means of bolts which passed through steel plates which were fastened to the ends of the bellows. The bellows, in turn, were secured to the hollow square stock on the bottom of the bus in the same manner. One of the bolts of each bellows, which was used to secure the bellows to the square stock, was hollow. Through means of two independent "leveling" or "height control valves", compressed air from the air reservoir was admitted to the two air chambers above each axle. The compressed air, travelling through the hollow bolts, caused the bellows to expand. This action lifted the bus away from the axles. When the bus had risen a pre-determined height, an arm which was connected to both the height control valve and the axle shut the air supply off to the chamber. In normal operation, the air pressure would remain inside the chamber and the bellows, thus maintaining the height of the bus above the axles. Hydraulic shock absorbers, combined with the air inflated belows, provided a smooth ride. The air suspension system could also compensate for changes in bus loads. For example, if a large number of people boarded the bus, the bellows would tend to sag because of the increased weight (mass). When this took place, the arm attached to the height control valve would be deflected. This action rotated the valve which allowed compressed air into the air chambers until the bus was raised to the correct height.

Conversely, if a large number of people left the bus, the height control valve would be rotated in the opposite direction by the arm. When this occurred, a small path was provided between the air chambers and an exhaust tube which led to the atmosphere. The air pressure inside the chambers would decrease slowly until the level of the bus dropped and the arm closed the valve. It should be noted that the height control valve incorporated a delay feature in order to prevent bumps and undulations in the road from affecting the air suspension. Since rubber bellows were not strong enough to hold the axles in position, steel radius rods with neoprene bushings prevented the axles from moving out of position. (Canadian Transportation, November 1953, pp. 651-652, and GMC Maintenance Manual, 1962, pp. 291-297)

Figure 39 (after Drawing in GMC Maintenance Manual, 1962, p. 291) shows the basic apparatus and the layout of the GMC air suspension system. It should be noted that the system was easy to maintain since no parts required lubrication and the only items that were designed to be replaced periodically were the bellows and the shock absorbers.

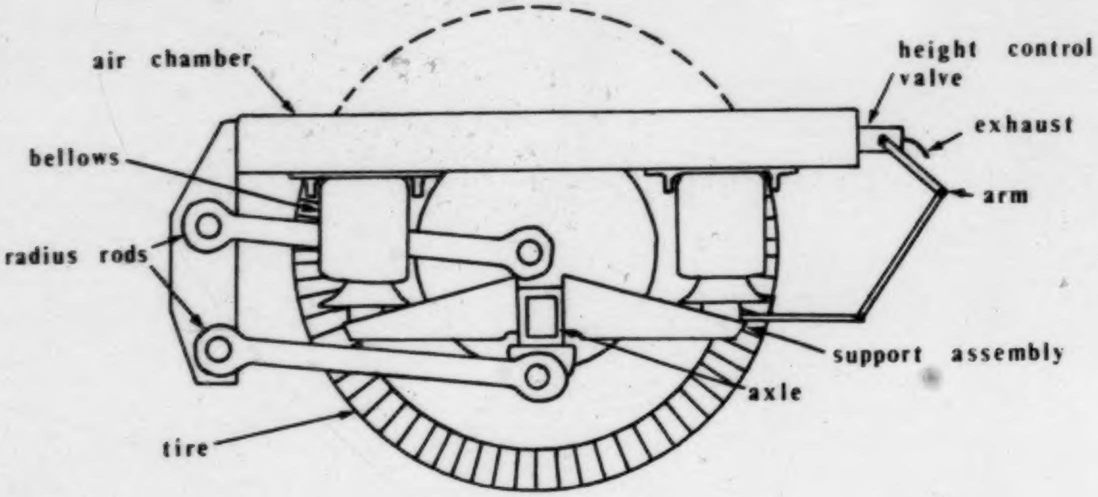

FIGURE 39. GENERAL LAYOUT OF AIR SUSPENSION

The heating system on the GMC TDH-5105 buses was not as elaborate as the heating system on the Mack buses. Air for the system was drawn in through a louver which was located above the front roller sign.

The hot air ducts were placed along the sides of the bus directly beneath the cross seats. Small openings in the ducts enabled the hot air to enter the interior of the bus. Like the Mack buses, however, the GMC buses were powered by a transversely-mounted rear diesel engine. The GMC engine was a large 188 H.P. (140 kW) six cylinder two-stroke engine in "V" configuration. (GMC Maintenance Manual, p. 265 & p. 274) The GMC 6V-71 engine was a compression ignition (CI) diesel engine like all the diesel engines used on the ETS in the past. Unlike the older diesel engine types, the 6V-71 engine had an air injection system. In all previously used diesel makes, the action of the pistons created a partial vacuum which drew air into the engine through the air cleaner. The 6V-71 engine, instead, had a gear driven blower assembly which provided some air pressure to the air reaching the engine's cylinders. This system of air injection enabled the engine to burn the fuel more efficiently, which resulted in a higher power output with fewer offensive exhaust fumes. (GMC Maintenance Manual, pp. 265-282)

The 6V-71 engine also had a provision for cold weather starting. If, for any reason, a bus was stored outside during extremely cold weather, it would be found difficult to start in the normal manner since the heat created by the piston action during starting would be drawn away from the fuel by the cold cylinder walls. The diesel fuel, therefore, would not be heated enough to cause combustion. To overcome this problem, GMC installed a small cylindrical cup onto the blower intake manifold. If the engine was to be started in cold weather, special plastic capsules of ether were to be placed in the cup. A pointed tube at the bottom of the cup punctured the capsule and allowed the ether to enter the engine. The ether was extremely volatile and usually combusted inside a cold engine's cylinders easily. In this manner, the engine was started without difficulty in cold weather. (GMC Operating Manual, 1960, p. 14)

The buses were equipped with directional signals as well as with a left-hand side directional lamp. Each brake, tail and directional lamp possessed its own lens, unlike previous ETS buses which had all the lamps clustered behind a single lens. (Author's Photographs) The centre exit door on these buses was manually operated by the passengers. (Canadian Transportation, January 1956, p. 35) This type of door was designed to overcome some of the winter freezing problems which occasionally affected treadle operated doors. The manual push doors were normally kept closed by a solenoid controlled pin. When the bus arrived at a stop and the operator had moved the selector valve to open the centre exit door, the solenoid would be activated and the pin would be withdrawn from the doors. At the same time, a light above the door with a large diameter green lens in front of it would be illuminated. The light indicated to the passengers that they could push the door open by means of a handle attached to the right-hand half of the door. When the handle was pushed, both halves of the door would open and the passenger could alight from the bus. When the handle was released, a strong spring above the doors pulled them closed. A small air piston attached to the spring could be adjusted to allow the doors to close slowly. Once the doors were fully closed, if the selector valve was in the "doors closed" position, the solenoid pin could drop back into the doors, keeping them closed. It should be noted that if a passenger pushed on the doors while the solenoid pin was holding them shut, a micro switch would be closed which completed a circuit to an electric bell. The bell warned the operator of this condition since it was possible for a determined passenger to break the solenoid pin and fall from the bus. The operation of the front doors, which were the folding type, was fully controlled by air operation. (GMC Maintenance Manual, 1962, pp. 39-43)

The buses were painted in the standard ETS colors except that a thin black stripe was applied to separate the red areas from the ivory areas. The buses were numbered 409 through 418 and were equipped with storm sashes. (ETS Listing of Buses, 1956) Plate 37 (Provincial Archives of Alberta) shows the front section of bus Number 415 as it appeared in February 1958.

The operation of these buses was successful and the ETS ordered an additional five units in 1956. These buses were numbered 419 through 423 and were identical to buses 409 through 418. (ETS Listing of Buses, 1956, and Photographs of GMC in Author's Collection)

An additional ten buses were required in 1958 and the Commissioners asked for bids. In addition to General Motors, bids were received from: Canadian Car and Foundry, Mack Manufacturing and Twin Coach. Both Mack and Twin Coach submitted bids for propane powered buses. Although Canadian Car and Foundry submitted the lowest bid, the contract was awarded to GMC. According to the City Commissioners, the GMC buses in operation were, "superior to any other equipment we operate" (Edmonton Journal, May 27, 1958). The Commissioners also noted that the ETS should standardize its fleet with the best equipment available since a vast array of parts would be required if the ETS continued to diversify its bus fleet. The purchase of the GMC buses was, therefore, approved by the City Council. (Edmonton Journal, May 27, 1958)

These buses, which were identical to the other TDH-5105 buses purchased earlier, were numbered 424 through 433 and were driven to Edmonton by a delivery firm from the GMC plant in Pontiac, Michigan. (Edmonton Journal, December 23, 1958)

The decision to acquire diesel buses ended the ETS program of conversion to propane operation since no new propane buses were purchased. The existing propane buses continued to be operated. (See Appendix I)

Equipment Disposal, 1957-1960

During this period, the ETS began to dispose of some of its older C-36 buses as the new GMC buses arrived. The ETS had discovered that it could sell some of its older units to smaller bus systems, thereby reducing the number of small gasoline buses in the ETS fleet. (ETS Inventory of Buses, 1966; see also Appendix I)

Equipment Modifications, 1958

The complaints about the odor of diesel bus exhausts persisted despite the introduction of air injected diesel engines. In an attempt to reduce the odors of the diesel exhaust, the ETS experimented with the addition of chemical masking compounds to the diesel fuel. It was discovered that the compound "Allmask D-1-2K" reduced the diesel exhaust odors better than other compounds. (Canadian Transportation, November 1958, p. 1) This compound was used by the ETS for several years.

New Equipment, 1960

In January, General Motors sent a demonstrator bus of their new transit model to Edmonton. The new model, TDH-5301, was mechanically similar to the TDH-5105 model but was entirely different in appearance. In addition, the new bus model contained better lighting and heating systems. (Edmonton Journal, January 25, 1960, p. 22) Although the new bus model was more expensive than the older model, the ETS placed an order for five. (Canadian Transportation, February 1960, p. 34)

The new TDH-5301 model used some aluminum structural members, like the older C-36 buses. The external sheathing below the side windows consisted of horizontally fluted aluminum panels which were chemically treated to prevent discoloration. The rear lamp housings were fabricated of fibreglass. (GMC Maintenance Manual, 1962, pp. 25-27) It should be noted that these buses were the first new units on the ETS to have been equipped with fibreglass parts.

The windows were much larger than the windows of the older GMC buses and were shaped like parallelograms with the exception of the fixed square window in the emergency door. The large openable windows on each side of the bus were hinged at the top and could be pushed out at the bottom in the event of an emergency. Standee windows were also provided. The standee windows were covered with long strips of green colored glass which was designed to reduce the glare inside the bus from direct sunlight. While the centre door arrangement on these buses was similar to the centre doors on the older GMC buses, the front doors were similar in design to the front doors on the Twin Coach buses. The design of the windshield also resembled the Twin Coach buses except the GMC windshields were larger and possessed thinner dividing strips between the individual windshield sections. (GMC Maintenance Manual, 1962, pp. 23-32)

The heating system on these buses consisted of a large bank of hot water heaters which were located in a sealed compartment beneath the bus near its centre. Hot water from the engine was circulated through the heaters by means of an electrically operated water pump. Air was drawn into the compartment through air ducts which were located on each side of the bus below one of the openable windows. Large electrically powered fans drew the air into the compartment past the heaters. It should be noted that replaceable filters were installed in the heating system between the air intake ducts and the heaters. The filters removed any large airborne particles in the incoming air. After the air was heated, the fans forced the air through the ducts which travelled along the sides of the bus interior. A space between the exterior panelling and the interior aluminum wainscoating permitted the hot air to escape along the top of the wainscoating, just below the windows. This arrangement evenly distributed the heated air throughout the interior as well as preventing the windows from fogging. Small intake ducts located beneath two of the cross seats enabled the air within the bus to be drawn into the heater compartment. The thermostat assembly was also located in one of those ducts. The heating system was supplemented, at the front of the bus, by an independent heater which was designed as a defroster for the windshield. Dampers at the operator's position enabled the operator to control the temperature in the front of the bus independently of the temperature in the remainder of the bus. (GMC Maintenance Manual, 1962, pp. 64-75) This type of heating system enabled storm sashes to be dispensed with. (Edmonton Journal, January 25, 1960, p. 22, and Author's Photographs) It should be noted that the interior surfaces of both the wainscoating and the exterior sheathing were coated with a thin layer of asphalt compound which was designed to deaden any vibrations and noises in the panels. (GMC Maintenance Manual, pp. 64-75)

The interior lighting was also improved. Instead of individual incandescent fixtures, these buses contained several fluorescent lamps which were placed in a line along the centre of the ceiling. The fluorescent lamps produced a more intense light without a large increase in required current. It should be noted that the fluorescent lighting system employed several transistors in conjunction with inductors in order to provide the appropriate voltage for the lamps. (GMC Maintenance Manual, pp. 257-264) This was the first application of solid state semiconductors on any ETS bus.

In addition to possessing corner clearance lamps, these buses were equipped with two sets of three clearance lamps each and they were located at the front and the rear of the bus above the windows in the centre. A right-hand rear view mirror was also included with these buses. This mirror permitted the operator to observe pedestrians and vehicles along the right-hand side of the bus. This type of mirror was subsequently installed on all other ETS buses. It should be recalled that the ERR streetcars had right-hand mirrors installed in 1912 to enable the motormen to observe the area to the right of the streetcar in order to prevent mishaps. In less than ten years after the abandonment of its streetcar service, the ETS began to re-introduce the use of the right-hand rear view mirror on its rolling stock.

A dual system of headlights was employed with the new GMC buses (two headlights each for the low and high beams). (GMC Maintenance Manual, 1962, pp. 249-256) The dual headlight system was designed to reduce the cost of lamp replacement since each sealed beam unit contained only one filament.

Except for the areas covered by the fluted aluminum panels, the buses were painted in the standard ETS colors. The black stripe between the red and ivory areas was omitted, however. Because of the large aluminum panels along each side, these buses were frequently referred to as "silverside" buses by ETS personnel. (ETS Listing of Rolling Stock, 1966) The five buses ordered in 1960 were numbered 434 through 438 and were driven to Edmonton from GMC's Pontiac, Michigan factory. (ETS Listing of Buses, 1962)

The appearance of the GMC transit bus body has remained unaltered basically since 1960. Buses Numbers 434 through 438, therefore, resembled the trolley bus which is shown in Plate 47. It should be noted that the paint scheme on the trolley bus was introduced during the late 1970's and was not initially applied to buses Numbers 434 through 438. The air intake duct below the second large window should be noted.

Equipment Modifications, 1960-1965

One item which required frequent and expensive maintenance on some of the older buses in the ETS were the leaf spring assemblies on the front and the rear axles. After prolonged periods of repeated flexing and relaxing, many of the leaf springs broke and they required repairs or replacement pieces. Such repairs or replacements were expensive and the bus remained unserviceable until the repairs were completed. In order to overcome these problems, the ETS experimented with an air suspension system on some of its motor and trolley buses. (Letter to Twin Coach Company of Canada Ltd. from ETS Superintendent D. L. MacDonald, March 9, 1960)

Special air suspension conversion kits were designed and manufactured by the Twin Coach Company of Canada which had ceased bus production but was continuing to make certain bus components. The conversion kits were applied to those vehicles which did not have an air suspension system and which were thought to have several more years of service left. Most of the 44-S and 45-S model Twin Coach buses, therefore, were fitted with the air suspension kits. In order to install the kits, most of the spring leaves were removed from the bus, the weight of the bus being borne by the air bellows. A few spring leaves were left in place to support the bottoms of the bellows and to hold the axles in position since these buses were not equipped with radius rods. By the end of 1965, the ETS had converted most of its older buses remaining in service to air suspension. In addition to reducing maintenance and repair costs, the new air suspension provided a smoother ride on the older vehicles. (Letter to the City Commissioners from ETS Superintendent D. L. MacDonald, December 3, 1964)

New Equipment, 1961-1962

In 1961, the ETS in conjunction with the Edmonton Public School Board began to provide school bus service in several large school districts within Edmonton. In order to provide this service, the ETS purchased five school buses. The first three units, numbered 801 through 803, were manufactured by the Oneida Company and were imported from the United States. These buses were similar in design to buses Numbers 1 through 4 except that the school buses possessed steel and aluminum bodies and were painted a bright yellow for safety purposes. Apart from the numbers, the only external lettering applied to the sides of the buses was the phrase "Edmonton School Bus" in black letters. (Letter to Commissioner D. B. Menzies from ETS Special Service Engineer J. A. Ross, May 24, 1963, p. 2, and Author's Photographs) The remaining two units consisted of International Harvester Company truck chassis and engines. Bodies fabricated by the Carpenter Body Works of Milton, Ontario were attached to the chassis. These buses were numbered 804 and 805 and were painted in the same fashion as buses Numbers 801 through 803. (ETS Listing of Rolling Stock, 1966, and Author's Photographs) Both makes of school bus were powered by gasoline engines and were not used for regular transit service. The ETS assigned these buses such high numbers so that the school buses could easily be distinguishable from regular transit buses.

An additional 15 school buses were ordered during 1962 from three companies: Carpenter, Superior Manufacturing and Bluebird Bus Company. (ETS Listing of Rolling Stock, 1966; see also Appendix I) These buses differed from the first group of school buses. They possessed full-length bodies which were similar in design to the bodies on Leyland buses Numbers 5 and 6. The new school buses could seat 72 pupils. In addition, these buses were equipped with a front roller sign which was mounted above the windshield. It should be noted that all the ETS school buses to this point possessed only one door on the right-hand side. The door was located near the front of the body and was controlled by a lever arrangement located to the right of the operator. (Author's Photographs) These buses were numbered 830 through 844. (See Appendix I) The higher numbers were used to distinguish these units, with full-length bodies, from the earlier school buses which possessed shorter bodies and protruding engines.

The ETS also ordered ten additional GMC TDH-5301 buses in June 1962 which were identical in appearance to buses Numbers 434 through 438. The new buses were assembled at the GMC plant in London, Ontario, hence the addition of the prefix "C" on the serial numbers. (See Appendix I; Letter to the City Commissioners from ETS Superintendent D. L. MacDonald, July 20, 1962) These buses were sent to Edmonton by rail since a reasonable freight rate was obtained. They were numbered 439 through 448. (See Appendix I)

In July 1962, General Motors informed the ETS that if they required any TDH-5301 buses in 1963, orders for them should be placed at an early date to avoid production delays. The ETS, therefore, recommended that 25 of the buses be ordered for 1963 delivery. This number was based upon ridership estimates for 1963. (Letter to the City Commissioners from ETS Superintendent D. L. MacDonald, July 20, 1962)

Buses Numbers 439 through 443, which had been ordered in June 1962, arrived during October while buses Numbers 444 through 448 arrived during January and February 1963. It should be noted that bus Number 445 never operated in Edmonton. Upon arrival in Edmonton, it was discovered that the bus had been severely damaged while in transit. A large section of the right-hand side was pushed in. This had resulted in the destruction of most of the windows and seats along that side as well as several structural members. It was the opinion of both the ETS Director of Equipment and the GMC representative that the bus was irreparable. The ETS refused to accept the unit. (Letter to ETS Superintendent D. L. MacDonald from ETS Director of Equipment S. R. Daviss, February 4, 1963) The CNR, who had transported the bus to Edmonton, reimbursed the City for the cost of the unit. The CNR, in turn, sold the bus to the Calgary Transit System where it was later repaired and placed in service as their Number 551. (Letter to ETS Superintendent D. L. MacDonald from W. T. Arnett, March 25, 1963, and ETS Listing of Rolling Stock, 1966)

Used Equipment, 1962

Increases in ridership, especially during peak hours, had left the ETS short of buses. In an attempt to overcome this shortage, the ETS purchased 20 used Twin Coach buses from the Winnipeg (Manitoba) Transit System during October. Ten of the buses were model 41-S which could seat 41 passengers, while the remaining ten buses were model 38-S which could seat 38 passengers. (Memorandum to the City Commissioners from

ETS Superintendent D. L. MacDonald, October 31, 1962) Both bus models were powered by gasoline-fueled FTC 180 engines. The buses were driven to Edmonton and were placed in service immediately. (Memorandum to ETS Superintendent D. L. MacDonald from Commissioner D. B. Menzies, October 24, 1962, and Edmonton Journal, November 3, 1962) As time permitted, the buses were repainted to the ETS colors and were given ETS numbers. The ten 41-S buses were numbered 501 through 510, while the ten 38-S buses were numbered 511 through 520. (ETS Listing of Rolling Stock, 1966; see also Appendix I)

Instead of the previously used decal crests and lettering, the ETS applied metal numbers as well as cast aluminum crests on these buses. The numbers and the crests were secured to the bus by means of screws. It had been discovered that the decals were not permanent because they frequently were worn off the buses when they passed through the rotating brushes in the wash racks in the various ETS service garages. (Edmonton Journal, November 3, 1962) The cast aluminum crests consisted of the letters "ETS" represented in a stylized script form. An example of the crest may be seen on Plate 38.

New Equipment, 1963

The 25 GMC TDH-5301 buses ordered in August 1962 arrived in Edmonton during February 1963. (ETS Listing of Rolling Stock, 1966) These buses were numbered 449 through 493. (See Appendix I) It is not known whether these buses came equipped with the new cast aluminum crests or the older decals.

The ETS ordered a further ten school buses in 1963. The order was split evenly between two companies, Carpenter and Bluebird. Other manufacturers, including Superior, were not considered since their bids were too high. (Letter to Commissioner D. B. Menzies from ETS Special Service Engineer J. A. Ross, May 24, 1963) The Carpenter buses were similar to the buses ordered previously. These units also came equipped with automatic transmissions and storm sashes for the side windows. Four of the five Bluebird buses were also similar to the units purchased previously and were also equipped with automatic transmissions and storm sashes. The fifth Bluebird bus was modified to include a manually operated centre exit door. In addition, this unit was also equipped with standee windows as well as additional stanchions and grab handles. The ETS ordered this particular type of school bus in order to place it experimentally in regular service. (Letter to Commissioner D. B. Menzies from ETS Special Service Engineer J. A. Ross, May 24, 1963) The buses were numbered 845 through 854, with Number 854 being outfitted for regular transit service. (See Appendix I)

During 1963, the ETS ordered an additional ten GMC buses. These units were to be GMC's new TDH-5303 model which was quite similar to the older 5301 model. The 5303 model, besides being slightly longer, possessed a different tail light configuration which dispensed with the use of a fibreglass housing. In addition, these buses contained fluorescent lamp illuminated advertising card holders which were placed along either side of the interior above the standee windows. These fixtures were used in lieu of centrally mounted ceiling fluorescent fixtures. (ETS Specifications of Rolling Stock, 1967, and Author's Photographs) The ten buses did not arrive until 1964. (ETS Listing of Rolling Stock, 1966, and Appendix I)

Equipment Disposal, 1960-1970

The gradual withdrawal of the C-36 buses continued during this period. Many of these buses had been in service over 15 years. While some of the buses were sold as operable units to other bus operators, many of the units had developed structural cracks. In addition, the Hall-Scott engines were beginning to require major rebuilding and replacement parts were becoming difficult to obtain. (ETS Listing of Bus Disposals, 1971, and Edmonton Journal, February 3, 1963) The C-36 buses that were in reasonable condition were sold to private individuals for personal use while those units with serious structural defects were stripped of all useable parts and were scrapped. All of the C-36 buses, including the units purchased from St. John, New Brunswick, were removed from service by the end of 1969 and the last surplus unit was disposed of in 1971. (ETS Listing of Bus Disposals, 1971; see also Appendix I) It is of interest to note that the ETS stored one of the C-36 buses for historical purposes and renumbered another C-36 bus and used it for storage purposes. (ETS Listing of Vehicle Registration, 1974; see also Appendix I)

During this period, the six Mack C-37DT buses were also removed from service. Although these buses were generally in better condition than the C-36 buses, the Mack diesel buses were smaller and could not efficiently transport large numbers of passengers. All of these buses were out of service by the end of 1966. (ETS Inventory of Buses, November 1966)

Lack of passenger capacity was not the reason why all the FLP-40 Twin Coach propane buses were scrapped during this period. These buses were extended versions of the Twin Coach model 45-S bus. When the FLP-40 model was designed, the basic substructure of the model 45-S bus was enlarged. The main longitudinal support members in the FLP-40 buses, although lengthened, were not increased in thickness.

These members, consequently, could not withstand the stresses placed upon them. As a result, the support members on several of these buses began to crack and were in danger of collapsing. In view of this condition the ETS, during 1965 and 1966, removed these buses from service and removed all useable parts. The bus bodies were then scrapped. (ETS Inventory of Buses, November 1966; see also Appendix I)

Several of the model 38-S Twin Coach buses purchased from Winnipeg during 1962 were scrapped during 1966. After many years of service in both Winnipeg and Edmonton, several of these buses were in poor condition. Bus Number 510, a former Winnipeg model 41-S Twin Coach bus, was also scrapped during 1966 because it had been involved in a severe collision and was not worth repairing. The remaining 41-S buses were renumbered 1 through 9, while the remaining 38-S buses were renumbered 11 through 14. This was the second time that these numbers were used by ETS for its buses. The buses were renumbered in order to provide numeric continuity to a new order of GMC buses that had arrived during 1966. (ETS Inventory of Buses, November 1966) Buses Numbers 1 through 9 and 11 through 14 were all withdrawn from service by the end of 1968 when new buses arrived to replace them. (ETS Listing of Bus Disposals, 1971; see also Appendix I)

It was mentioned in the previous section that school buses Numbers 801 and 802 were traded in on new buses during 1963. The remaining school buses that had been purchased before 1963 were all withdrawn from service and were sold by the end of 1970. (ETS Listing of Bus Disposals, 1971; see also Appendix I)

New Equipment, 1964-1967

The ten GMC model TDH-5303 buses that had been ordered during

1963 arrived during 1964. These buses were painted in the standard ETS colors and were equipped with the new ETS aluminum crests. (Author's Photographs) The buses were numbered 474 through 493. (See Appendix I)

The previous section described how many of the older ETS buses were being withdrawn from service during the 1960's. The City was reluctant to replace these buses with expensive GMC units so the ETS was encouraged to solicit bids from foreign bus builders. It was believed by the City that offshore manufacturers could design suitable "prototype" buses to Edmonton's specifications and could supply the buses to the City at a cost approximately below that of domestic manufacturers. (Letter to Mitsui and Co. Manager F. Kakehi from ETS Superintendent D. L. MacDonald, January 24, 1964)

During 1963, Mitsubishi Heavy Industries and the Fuso Coach Works both of Japan had designed a diesel powered motorbus for the Western Canadian market based upon specifications supplied by the Winnipeg Transit System. One prototype bus, designated model MAR750L, was assembled by the end of 1963 and was shipped to Canada where it was operated in Winnipeg as a demonstrator. In March 1964, the bus arrived in Edmonton where it was purchased by the ETS which was eager to try different types of buses in regular service over long periods of time. (City of Edmonton Material Purchase Requisition A 75533, March 5, 1964, and Letter to the City Commissioners from Mitsubishi International Corporation, May 29, 1964)

The Mitsubishi-Fuso bus was quite similar in both appearance and construction to the recent GMC buses in service on the ETS. The Mitsubishi-Fuso bus, however, contained several different features. A large rear mounted four-stroke V-8 diesel engine was supplied with this bus for additional power on steep grades. This particular type of diesel engine (four-stroke) employed a complicated system of electrically-powered glow plugs in the cylinder to assist with starting. (Mitsubishi Specifications of Model MAR750L Bus, p. 1) The heating system was also different on this bus. In addition to a coolant-heated hot air heater and defroster, this unit was supplied with an auxiliary heater which burned diesel fuel for heat. This unit, which was located beneath the right-hand side of the bus near its centre, employed a heat exchanger and a fan to introduce heated air into the bus. The operation of the auxiliary heater was controlled by a thermostat located in the interior of the bus. Fibreglass insulating material was used in the construction of this bus. (Mitsubishi Specifications of Model MAR750L Bus, p. 8)

The interior could seat 51 passengers and possessed a treadle-operated centre exit door. Interior lighting was provided by ceiling mounted fluorescent lights which were arranged in a similar manner to the lighting in the GMC TDH-5301 buses. (Mitsubishi Specifications of Model MAR750L Bus, p. 5 & p. 8) The exterior lighting included clearance and directional lamps as well as yellow fog lamps which were located directly below the headlights. (Mitsubishi Specifications of Model MAR750L Bus, p. 9)

Upon arrival in Edmonton, the bus was painted in a special version of the ETS colors and was numbered 10. While the upper portion of the bus was painted ivory, the areas below the windows consisted of three horizontal bands of different colors. The ETS red was placed immediately below the windows and as a trim around the front and rear windows. A much wider band of grey paint was applied between the red paint and the bottom of the fog lights and the tail light assemblies. The lowest portion of the bus was painted ivory. (ETS Listing of Rolling Stock, 1966, and Color Photograph in Author's Collection)

After a short period in service, the Mitsubishi-Fuso bus was found to have several deficiencies which made it unsatisfactory for use in Edmonton. One major deficiency was that the bus operators had extreme difficulty in steering the bus because of its small diameter steering wheel. The four-stroke engine was prone to frequent breakdowns which resulted in the bus being out of service for prolonged periods of time while replacement parts arrived. The most significant problem, however, was the difficulty service and repair crews had in reaching components such as the torque converter. (Memorandum to ETS Superintendent D. L. MacDonald from ETS Director of Equipment S. R. Daviss, May 1964, and Letter to Metropolitan Corporation of Greater Winnipeg from ETS Director of Equipment S. R. Daviss, June 14, 1971)

Other prototype buses were purchased by the ETS during 1964. The Nissan Motor Company of Japan, which marketed "Datsun" and "Nissan" automobiles in Canada, designed a prototype bus for the ETS according to their specifications. For evaluative purposes, the ETS ordered three of the prototype buses from Nissan in April 1964. (Letter to the City Commissioners from ETS Superintendent D. L. MacDonald, April 24, 1964) These buses, designated Model 6RLA110-K2, were similar to the GMC buses in construction. The model designation described some of the main features of the buses. The "6" referred to the number of engine cylinders, while the "R" signified that the engine was located in the rear of the bus. The "L" stood for left-hand drive, while the "A" signified that air suspension was used. The "110-K2" referred to the body configuration. (Specifications of Nissan Model 6RLA110-K2 Diesel Bus, March 1964, p. 1)

The engine was a six cylinder inline two-stroke diesel which operated in a similar fashion to the GM 6V-71 diesel engine. The Nissan UD6 engine, however, was mounted longitudinally at the rear of the bus because of its increased length. In order to accommodate the engine, the floor of the bus was raised near the rear of the interior. The torque was transmitted from the engine to the rear axle through a torque converter. The torque converter was designed so that it was operated by two levers which were located at the operator's position. One lever selected the direction of travel, while the other lever selected the gear range within the converter. (Specifications of Nissan Model 6RLA110-K2 Diesel Bus, March 1964, pp. 4-8)

The Nissan prototype, unlike the GMC buses operated by the ETS at that time, used steel for the majority of the structural members and for the sheathing. In order to keep weight to a minimum, the thickness of the panels was reduced, which increased their vulnerability to damage from blows. Aluminum foil insulation was installed between the interior and the exterior surfaces of the bus. (Specifications of Nissan Diesel Bus, p. 12) The heating and the interior lighting systems were similar to the systems found on the GMC buses of that period. The Nissan buses also contained a public address system which enabled the buses to be used for guided tours in the City. The windows on these buses were larger than the windows on the GMC buses. This feature eliminated the need for standee windows. The upper quarter of the side windows could be opened, while the remainder of the window was sealed. This design prevented passengers from sticking their appendages out of the windows.

Both the front and the side roller signs were illuminated. The front roller sign was designed in three separate rollers in order that two different termini could be displayed in addition to a route designation. External fog lamps were also applied to these buses. The lamps were located directly beneath the headlights. (Specifications of Nissan Diesel Bus, p. 14, and Plate 38)

These buses were painted in the standard ETS colors and arrived in Edmonton without numbers or crests. Plate 38 (City of Edmonton Archives) shows the appearance of one of the prototype buses upon its arrival in December 1964. All of the prototype units arrived during December. These buses were numbered 601 through 603. (ETS Inventory of Buses, 1966, and Author's Photographs)

The ETS found itself short of buses in 1964 as the result of the annexation of the Town of Jasper Place by the City of Edmonton. The City was obliged to provide adequate transit service to the new area so the ETS attempted to obtain suitable buses as quickly as possible. (Letter to the City Commissioners from ETS Superintendent D. L. MacDonald, April 24, 1964) The successful experiment of using school bus Number 854 for transit service prompted the ETS to order 14 of the "transit" type of school bus from the Bluebird Bus Company by the end of April 1964. These buses were equipped with: standee windows, air brakes, and air operated front and centre doors. The buses were to be used in regular transit service until proper transit buses were obtained. The transit school buses would then be used solely for the transportation of school pupils. (Letter to the City Commissioners from ETS Superintendent D. L. MacDonald, April 27, 1964)

The buses were painted in standard ETS colors and were numbered 855 through 868. They arrived in Edmonton during September 1964. (ETS Inventory of Buses, 1966; see also Appendix I) Plate 39 (Author's Collection) shows bus Number 861 in the ETS livery during early 1965. The roller sign showing a route to Jasper Place should be noted.

An additional six Bluebird regular school buses were also purchased

Plate 38. (City of Edmonton Archives) A Nissan Bus at the Time of Delivery in 1964

Plate 39. (Author's Collection) Bluebird "Transit" School Bus Number 861

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during 1964. (See Appendix I) These buses were numbered 869 through 874 but were not painted in the ETS colors. (Author's Photographs)

In early May 1964, the ETS negotiated with the British Daimler and Duple Companies for the production of a suitable prototype bus for the ETS. (Press Release from ETS Superintendent D. L. MacDonald, May 14, 1964) By September, the prototype had been developed and was planned for production. The ETS ordered three prototype units for evaluation. (Letter to the City Commissioners from ETS Superintendent D. L. MacDonald, September 10, 1964, and CECR No. 40, September 14, 1964)

The design of this bus was a regression to the bus building techniques common before the Second World War. The buses were to consist of a welded steel chassis fabricated by one company with a body that was manufactured by another company. It should be recalled that the original motorbuses 1 through 10 were manufactured in this fashion. Unlike the earlier motorbuses, however, these units were assembled from components gathered from five separate companies. The chassis were manufactured by Daimler Transport Vehicles of Coventry, England. These chassis were designed to support a longitudinally-mounted rear diesel engine. The engine selected for these buses was a British manufactured Cummins six cylinder diesel in "V" configuration. The torque converter selected for these buses were manufactured in Britain by the Allison Company, a GM subsidiary. (Letter to Edmonton's Director of Purchasing from Daimler Transport Vehicles, February 4, 1965)

The bodies were manufactured by Duple Motor Bodies Limited and consisted of steel framing with aluminum and fibreglass panels on the exterior. Fibreglass panels were used for the front and the rear panels only. The exterior panels were secured to the frame with aviation-type pop rivets instead of the solid type of rivets that were commonly used by other bus manufacturers. The interiors were finished with plywood for the floors and wainscoating, and fibreglass panels for the ceiling. Fibreglass insulation was installed between the exterior and the interior of the body. (Duple Specifications of Metal Framed Transit Coach, 1965) Because the chassis incorporated low ground clearance, only single steps were required at the front and at the centre exit doors. The flooring, however, had to be sloped near the rear in order to accommodate the engine. The windows on these buses were similar to the window design of the Nissan buses. The general appearance of the Daimler-Duple buses were similar to the Nissan buses as well. Fog lamps, however, were not installed on the Daimler-Duple buses. Illuminated front and side roller signs were provided. While the front roller sign could display termini as well as route designations, the side and the rear roller signs could display route designations only. It should be noted that the side roller sign was incorporated into the roof above the side windows. The heating system on these buses was designed and installed by the Clayton-Dewandre Company who also supplied a front defroster. (Duple Specifications of Metal Framed Transit Coach)

When complete, the buses were to be painted in the standard ETS colors and shipped to Edmonton. (Duple Specifications for Metal Framed Transit Coach) The entire bus was known as model SRC6, or "Roadliner". (CECR No. 40, September 14, 1964) Production difficulties delayed the construction of the prototype buses until 1966. (Letter to ETS Superintendent D. L. MacDonald from Duple Sales Group, March 2, 1966)

By late 1964, the ETS determined that it would require 35 additional transit buses during 1965. Seven bus manufacturers submitted bids. Of the seven, only two were domestic builders. It was the opinion of the ETS management that foreign buses should be purchased since such buses were far less expensive than domestic buses and there seemed to be very little difference in technology between foreign and domestic buses. (Report to the City Commissioners from ETS Superintendent D. L. MacDonald, December 11, 1964) At this point, the ETS owned one Mitsubishi-Fuso and three Nissan prototype buses. None of the Daimler-Duple prototype buses had yet arrived. Based on their experience with the Nissan buses, the ETS recommended the purchase of ten production units. In his report to the Commissioners, Superintendent MacDonald stated, "These buses as evidenced by their prototype appear to be very well built" (p. 4). The remaining 25 buses were ordered from Daimler-Duple. This decision was based upon low cost and the design of the bodies. (Report to the City Commissioners from ETS Superintendent D. L. MacDonald, December 11, 1964, p. 4)

Although both types of buses were equipped with diesel engines, Superintendent MacDonald noted that the buses were designed so that they could easily be converted to trolley bus operation or could be fitted with propane-fuelled engines, including small gas-turbine engines. It should be noted that propane-fuelled bus engines were no longer being manufactured. (Report to the City Commissioners from ETS Superintendent D. L. MacDonald, December 11, 1964, p. 4)

The ETS submitted an extensive list of modifications to the Nissan buses before the production run of ten buses was started. In addition to several minor modifications to the interior, the ETS asked to have the dual selector lever arrangement for the torque converter replaced by a single lever in order to avoid operator confusion. The treadle unit for the centre exit door had been found to be prone to failure during cold weather, and the ETS requested that a manually operated push door be supplied with the production units. In addition, the ETS had found that the fuel tanks were too small on the prototype buses so the ETS requested that the tank size be increased from 44 imperial gallons (200 L) to between 85 and 90 gallons (386 to 409 L). (ETS Listing of Modifications for Future Nissan Buses, 1964, and Nissan model 6RLA110-K2 Owner's Manual, 1965)

None of the Nissan or Daimler-Duple buses arrived during 1965. In January 1966, the ETS determined that it required 17 new buses as soon as possible in order to be able to provide service on new routes. (CECR No. 66, January 24, 1966) The ETS recommended that the buses be purchased from GMC for two main reasons. Firstly, buses of a large capacity were required, which eliminated most of the foreign builders. Secondly, the buses had to be ready for service immediately upon arrival and could not spend time in the shops undergoing modifications. (Letter to the City Commissioners from ETS Superintendent D. L. MacDonald, January 27, 1966) The City Council approved the recommended bus purchase in February. (Letter to the City Commissioners from ETS Superintendent D. L. MacDonald, February 10, 1966)

The buses were model TDH-5303 and were similar to the last order of GMC buses. The new buses were numbered 494 through 510 and arrived in Edmonton during June 1966. (ETS Specifications of buses, September 1972)

The new Nissan buses arrived during February and March 1966. The buses were numbered 604 through 613 and were identical in external appearance to the prototypes 601 through 603. The production units, however, incorporated the various modifications requested by the ETS. (Nissan Model 6RLA110-K2 Owner's Manual, 1965)

The Daimler-Duple buses began to arrive after March 1966. The buses were numbered 701 through 728, with 701 through 703 being the prototype units. Bus Number 701 was the first unit to arrive. (ETS Listing of Daimler Buses, January 1968; see also Appendix I) Production difficulties delayed the arrival of the other buses. They arrived sporadically between September 1966 and October 1968. (ETS Listing of Daimler Buses, 1968; see also Appendix I)

Serious problems began to manifest themselves in these buses before the end of 1966. The Allison transmissions had tended to fail in such ways that they became seriously damaged, resulting in long repair periods for the buses. (Letter to Daimler Transport Vehicles from ETS Assistant Director of Equipment L. F. Wiebe, August 30, 1967) Other problems developed with these buses. They included: the overheating of the engines, uneven brake application, difficulty in engine starting, small fuel tank capacity, excessive vibration of the body, excessive noise in the interior caused by vibrations and the heating system, and solid particles entering the air intakes. (Letters to Daimler Transport Vehicles, from ETS Assistant Director of Equipment L. F. Wiebe, January 26, and February 14, 1968) Extensive modifications were required if these buses were to be serviceable units.

New Equipment, 1967-1969

The ETS required an additional 25 buses for 1967 and recommended that the units be purchased from GMC. Foreign built units were not considered because the foreign buses in service on the ETS did not perform as well as the GMC buses. Superintendent MacDonald stated,

> The City of Edmonton has given a great deal of encouragement to foreign bus builders and ordered a number of such vehicles . . . . This experience has proven that a very great deal of development must be accomplished to provide suitable equipment to meet the stringent requirements of bus operation here. (Letter to the

City Commissioners from ETS Superintendent D. L. MacDonald, November 24, 1966)

The Commissioners and the Council both approved of the ETS recommendations and the 25 buses were ordered from GMC. (CECR No. 4, November 28, 1966) The buses were model TDH-5303 and were similar to the previous group of GMC unit obtained by the ETS. The buses were numbered 511 through 535 and arrived in Edmonton during 1967. (ETS Specifications of Buses, September 1972; see also Appendix I)

By 1968, most of the smaller gasoline and diesel buses had been withdrawn from service. Many of those buses had operated over the lower deck of the narrow High Level Bridge. The ETS believed that the longer buses in its fleet could not easily traverse the bridge so the ETS requested the purchase of a number of shorter GMC buses for those routes over the High Level Bridge. (Letter to the City Commissioners from ETS Superintendent D. L. MacDonald, February 20, 1968) The City Council approved the purchase of ten such buses. (CECR No. 7, February 26, 1968)

These buses were identical in appearance to the larger GMC buses in the ETS fleet. The new buses, however, were shorter in length and were equipped with white reverse lights at the rear, and catalytic mufflers. A catalytic muffler was a device which was attached to the exhaust pipe and, in addition to reducing the exhaust noise, directed the exhaust through a number of ceramic beads which were coated with a catalyst; the catalyst accelerated chemical reactions which oxidized and neutralized many of the odors and toxic substances in the exhaust. In addition, these buses contained a public address system to enable them to be used for guided tours. (Letter to the City Commissioners from

ETS Superintendent D. L. MacDonald, February 20, 1968)

A new model designation was used by GMC for these buses. The middle letter in the three letter prefix was replaced by a numeral which indicated the number of cylinders of the engine supplied. The new buses, therefore, were referred to as model T6H-4521. (ETS Specifications of Buses, 1972) The buses were numbered 1 through 10 (the third use of these numbers) and were delivered to Edmonton during 1968. (See Appendix I)

The City Commissioners also instructed the ETS that no buses were to be purchased for the system unless that type of bus had been successfully operated in: Calgary, Winnipeg, Regina and Saskatoon. (CECR No. 7, February 26, 1968) This instruction effectively prevented the purchase of any further foreign built buses by the ETS.

An additional 15 GMC T6H-4521 buses were purchased during 1969. (Memorandum to ETS Superintendent D. L. MacDonald from Commissioner S. J. Hampton, June 11, 1969) The buses were numbered 11 through 25 and were identical to the last order of that model. (ETS Specifications of Buses, 1972; see also Appendix I)

The ETS had also received a bid for 51 passenger capacity buses manufactured by the Western Flyer Company of Winnipeg, Manitoba. The City was reluctant to purchase any Flyer buses because of the ETS's disastrous experience with the Daimler-Duple buses. Superintendent MacDonald, however, felt that the City should observe this make of bus, since it was a domestic product, and such buses were in use in Winnipeg. (Memorandum to Commissioner S. J. Hampton from ETS Superintendent D. L. MacDonald, June 10, 1969)

Equipment Modifications, 1968-1970

The problems with the Daimler-Duple buses (described in a previous section) were gradually dealt with by the companies concerned. Recurring engine and transmission problems were never resolved on these buses. Long delays in the repairs were encountered because the different companies could not agree on who was responsible for each modification and repair required. As a result of these long delays and recurring problems, no more than half of the Daimler-Duple buses were available for service at any given time. This situation placed ETS operations in a precarious position because of the unreliability of these buses. The disastrous performance of the Daimler-Duple buses gave the City a very poor impression of foreign buses, and of British buses in particular. (Minutes of Special Meeting, March 26, 1968) Although the Daimler-Duple buses had been less expensive than other buses in the ETS fleet, their poor reliability combined with poor after-sale service by the various manufacturers convinced the City that such buses should not be ordered in future. (Letter to the City Commissioners from ETS Superintendent D. L. MacDonald, February 20, 1968)

The Mitsubishi-Fuso bus was renumbered 600 from 10 in 1968 because of the arrival of the short GMC buses which were numbered 1 through 10. (See Appendix 1)

New Equipment, 1971

The ETS obtained the use of a Western Flyer Company model D700A demonstrator diesel bus on a one year lease. (Memorandum to ETS Superintendent D. L. MacDonald from ETS Director of Equipment S. R. Daviss, April 14, 1972) The D700A was very similar in appearance to the GMC buses in use on the ETS. The bus was equipped with a 6V-71 engine manufactured by Detroit Diesel, a subsidiary of GM. The engine was mounted longitudinally at the rear of the bus. A Spicer torque converter was also supplied with the bus. The longitudinal mounting of the engine meant that many of the auxiliary devices, such as the alternator, had to be driven by belts instead of by gears, as was the normal arrangement for engines in the GMC buses. The use of belts was not satisfactory since they were difficult to reach and they frequently wore out. The heating system on the bus, as well as its interior appointments, were similar to the GMC TDH-5303 buses in the ETS. (Western Flyer Company Specifications of Series D700A Bus, 1970) The unit was originally painted in the colors of the Winnipeg Transit System but the unit was numbered "700" by the ETS. (Author's Photograph)

Equipment Modifications, 1971

Problems with foreign-built buses were not limited to the Daimler-Duple buses. The Nissan buses had been encountering recurring problems with their diesel engines. The ETS hoped to reduce repairs on these buses by replacing the existing engines with engines of a different make. In early 1971, the UD6 engine in bus Number 601 was replaced with a GM 6V-71 engine as an experiment. Although the engine functioned properly, it precipitated problems with the transmission and with auxiliary systems. The experiment was not considered a success and the ETS abandoned further plans to replace the UD6 engines in the Nissan buses. (Canadian Coach, February 1971, p. 5)

Equipment Disposal, 1970-1977

The ETS disposed of most of their prototype and foreign buses during this period. The Mitsubishi-Fuso bus, Number 600, had seen little regular service. Some individuals expressed an interest in the bus so the ETS leased the unit for a trial period. On its initial run from Edmonton in June 1971, a serious coolant leak developed in the engine. This leak led to the engine seizing. The ETS decided that it would not be economical to repair the unit so it was sold as a non-operational unit suitable for parts. (Letter to R. W. Church from ETS Director of Equipment S. R. Daviss, June 14, 1971)

The entire fleet of Nissan and Daimler-Duple buses were retired between 1973 and the end of 1974. Prior to this time, these buses had been used for charters and for standby service only because of their poor reliability. (Edmonton Journal, January 6, 1973, p. 3) All of the buses were either sold or were scrapped, with the exception of bus Number 707 which was used by the ETS as a travelling information bus (Infobus). (ETS Listing of Equipment Disposals, 1977, and Author's Photographs; see also Appendix I)

The remaining gasoline and propane powered Twin Coach buses were also retired from service during this period. The operation of these buses was terminated by the end of 1975. (ETS Interdepartmenal Memorandum from S. R. Daviss to B. Aseltine, December 22, 1975) Bus Number 59 was preserved, while the remainder were either sold or scrapped. (See Appendix I) It is important to note that many of the propane powered Twin Coach buses had been in service almost 25 years, while the Nissan and the Daimler-Duple buses had been retired after less than ten years of service. It is evident that the older Twin Coach buses were superior in construction and design to the foreign-built buses.

The regular school and the transit school buses were also retired and sold during this period. The age of these buses, combined with increased maintenance costs and the arrival of the new units, were the factors which led the ETS to retire the older school buses. (ETS Notices of Surplus Bus Sales, 1974-1977; see also Appendix I)

New Equipment, 1972-1974

The ETS purchased the leased Western Flyer bus for long term evaluation. The bus was painted in ETS colors at this time. The ETS did not consider the bus equivalent to the GMC buses in either construction or performance. (Memorandum to the City Commissioners from ETS Superintendent D. L. MacDonald, April 14, 1972)

A total of 34 new GMC buses were required by the ETS during 1972, and were ordered. (Memorandum to the City Commissioners from ETS Superintendent D. L. MacDonald, April 14, 1972) The buses were GMC's new model T6H-5307N. The basic design of the 5307N was similar to the older 5303 model. It should be noted that the "N" suffix signified that the model did not contain air conditioning apparatus. The 5307N model also contained several new features not found on the older 5303 model. The older 6V-71 engine was replaced by a more powerful version which was known as the 6V-71N. This engine, in addition to having a maximum output of 219 H.P. (163 kW), contained a catalytic muffler, a special external air intake, and a vertical exhaust. (ETS Specifications of Buses, 1972, and Author's Photographs) The extreme left-hand and right-hand portions of the rear windows were replaced by the intake housing and the exhaust assembly. The air intake, located on the right-hand side, consisted of a chemically blackened sheet steel duct which was angled towards the right-hand side of the bus. The exhaust was located on the left-hand side and consisted of an exhaust pipe which travelled vertically behind a protective blackened sheet steel cover. As the pipe neared the roof of the bus, it was curved so that it bent away from the bus, towards the rear. (Author's Photographs) In this manner, the exhaust fumes were distributed above street level and away from the bus. It should be recalled that the SRD had experimented with vertical exhausts during the Second World War with disastrous results. The expulsion of large particles of soot, which was a problem with the original vertical exhausts, was not a problem with GMC's vertical exhaust system because of the action of the catalytic muffler.

Two adjacent treadle-operated centre exit doors were provided with each bus. The double doors were designed to facilitate rapid passenger unloading. Each door assembly consisted of two folding halves which were fabricated from sheet steel. These doors were similar in appearance and operation to the doors of the C-36 buses. (See Plate 37) The treadle apparatus consisted of hollow rubber mats placed on each step tread. The rubber mats contained electrical contacts which were normally open, and were closed by the action of a person stepping on the mat. After the person had stepped off the mat, the resilience of the rubber was supposed to open the contacts, thus allowing the door to close. (Author's Observations) It should be noted that these buses were not equipped with an emergency door. Instead, special levers were installed on each window which enabled the bottom of the window to be easily swung out during an emergency, allowing the passengers to escape. Signs placed adjacent to the levers instructed the passengers on their use. (Author's Observations)

The interior seating arrangement of these buses could each accommodate 49 passengers. In addition, an illuminated sign was attached to the ceiling of each bus near the front. When a passenger pulled the signal cord, the signal bell would ring once and small bulbs inside the sign would be energized. The sign read "next stop" in red lettering.

Once the sign was illuminated, the signal bell became inoperative. A red indicator light on the operator's dash was also illuminated when the signal cord was pulled. Upon reaching a stop, if either the front or the centre doors were opened, the illuminated sign and the operator's indicator light would both be extinguished and the signal bell would be made operational again. (Author's Observations) This visual aid assisted both the passengers and the operator in knowing whether a stop was requested. The new buses, numbered 536 through 569, arrived in Edmonton during October and November 1972. (See Appendix I)

By mid 1973, the ETS estimated that it would require an additional 41 motorbuses in 1974. The order for the buses was unevenly split between GMC and Flyer Industries Limited (formerly Western Flyer Company). (Canadian Coach, July-August 1973, p. 14) Thirty-one buses were ordered from GMC. Ten of the buses were to be model T6H-4523N, while the remaining 21 were to be model T6H-5307N. The T6H-4523N model was the short version of the 5307N model which was described in a previous paragraph. The ten T6H-4523N buses were numbered 26 through 35. These numbers ensured that all of the shorter buses were kept in numerical sequence. The 21 T6H-5307N buses were identical to the previous order of buses received by the ETS. These units were numbered 570 through 590. All of the GMC buses in this order arrived in Edmonton during November and December 1973. (ETS Listing of Buses, 1979)

The ten buses ordered from Flyer Industries were their new 800 series, model D10240. The 800 series was available in either motorbus or trolley bus configuration. The model designation revealed important features of the bus. The initial letter, in this case a "D", indicated that the bus was powered by a diesel engine. The following numbers were the width of the bus in inches, and the length of the bus in feet; 102 inches (2 591 mm) wide and 40 feet (12 192 mm) long. (Flyer Industries Specifications of 800 Series Buses, 1974)

The construction of the Flyer buses was similar to the construction of the GMC buses. Flyer Industries, however, had improved the ruggedness of the body construction of the 800 series over the previous 700 series. The appearance of the buses had also been altered so that they did not resemble the GMC buses as much. The framework of the 800 series was made stronger than the framework of the 700 series by the inclusion of two "U" shaped steel longitudinal members. The external sheathing consisted of aluminum, fibreglass and stainless steel panels which were secured to the framing with aviation rivets. Large rectangular windows which were hinged along the tops were supplied with these buses. The large format of the windows eliminated the need for separate standee windows. One peculiar feature of the early 800 series Flyer buses was the inclusion of a triangular-shaped metal housing which was placed on the roof of the bus at the rear. This housing was designed to enclose optional air conditioning apparatus. (Flyer Industries Specifications, 1974) Like the GMC buses, the Flyer 800 series buses did not contain emergency doors but they were equipped with window escape levers and signs. In addition, the Flyer buses were also provided with treadle-operated double exit doors. (Author's Photographs) The prime mover, transmission and the heating system in the 800 series diesel bus were identical to those found on the older 700 series diesel buses. A vertical exhaust, which was entirely enclosed by the left rear corner of the body, was provided with the 800 series. It should be noted that polyurethane foam as well as fibreglass was used to insulate the 800 series buses. (Flyer Industries Specifications, 1974 and Author's Photographs)

The Flyer buses were painted in the standard ETS colors and were sent to Edmonton during July 1974. It should be noted that the side panels on these buses were not painted, as was the fashion with the GMC buses. The new Flyer buses were numbered 731 through 740. (Author's Photographs; see also Appendix I)

By the end of 1973, the ETS had determined that an additional 31 large motorbuses would be required by the end of 1974. (Canadian Coach, May-June 1974, p. 16) The buses were ordered from GMC and were identical to the previous group of T6H-5307N buses received by the ETS. The buses were painted and numbered before being sent to Edmonton during November and December 1974. It is important to note that 11 of the buses were incorrectly numbered by GMC. The buses were originally numbered 591 through 621. (GMC Photograph of Bus Number 621, in Transit Canada, July-August, 1975, p. 4) Although the numbering on buses 591 through 600 was correct, the numbers on the remainder of the order conflicted with some of the Nissan buses which had not yet been retired. (See Appendix I) In order to avoid confusion, the ETS renumbered the new GMC buses from 601 through 621, to 301 through 321. (ETS Listing of Buses, 1979)

New Equipment, 1975-1979

The rapid growth of Edmonton during this period prompted the ETS to expand its services. In late 1974, therefore, the ETS received approval from City Council to order 75 T6H-5307N buses from GMC for service expansion. (Canadian Coach, November-December, 1974, p. 18) The buses were to be similar to the last T6H-5307N units received by the ETS except for two changes. Considerable difficulty had been experienced with the folding centre exit doors so the ETS specified that single leaf doors, similar in appearance to the manual push doors, should be supplied. The treadle mechanism would be retained, however. In addition, the centre exit steps were redesigned so that the bottom tread was two inches (51 mm) closer to the ground. This feature made it easier for some passengers to alight from the bus. (Transit Canada, July-August 1975, p. 4)

The second change on these buses was that the standee windows were omitted. The lighting system of the GMC buses, described in a previous section, provided illuminated advertising card racks which were located between the standee windows and the ceiling. In addition to being small, the card racks were thought to be too high for most passengers to want to read them. The need for standee windows was also questioned, as it was believed that most passengers did not use them. In order to increase advertising revenues, therefore, the ETS specified that the new buses were to be equipped with larger illuminated card racks instead of standee windows. (Author's Photographs)

The buses were numbered 322 through 371 and were delivered in two groups. Buses 322 through 371 had seating for 49 passengers, while the seating arrangement on buses 372 through 396 could accommodate 47 passengers each. This latter seating arrangement was designed to provide passengers with increased leg room in the cross seats. (ETAR, 1979, p. 30, and Author's Photographs) Buses 322 through 371 arrived during July and August 1975, while buses 372 through 396 arrived during December 1975. (ETS Bus Licensing Data, December 1975)

Ten new regular full-length cab Bluebird school buses were ordered during 1974. These units, which were similar to the school buses purchased during the mid 1960's, were designed to replace the older school buses that were being retired. The new school buses were not painted in ETS colors and were numbered 801 through 810. The units were delivered during 1975. (ETAR, 1979, p. 13 & p. 30)

During 1975, the ETS ordered an additional 60 GMC T6H-5307N buses for 1976 delivery. Several mechanical modifications were to be included with these units. The ETS had found that the air filters on the buses equipped with the large external air intake were becoming extremely dirty within a short time, compared to buses with additional interior air intakes. The new buses ordered from GMC were to be equipped with additional interior air intakes as well as the external air intake. An additional change was made to the compressed air system. In the past, alcohol evaporators had been used to prevent components from freezing during winter. The evaporators, however, did little to control the amount of compressor oil and water condensate which accumulated in the system. Accumulations of condensate had to be drained from the air reservoirs at frequent intervals. In extremely cold weather, the condensate could freeze, which damaged the air system. To overcome this problem, the ETS requested the installation of a Bendix-Westinghouse Company air dryer system on each new bus. (Transit Canada, July-August 1975, pp. 19-20) The air dryer consisted of a large steel cylinder which was divided into two sections internally and which was mounted vertically. The upper half of the dryer unit consisted of an empty chamber and an outlet coupling, while the lower half contained a desiccant material, several oil removal filters, a water collection sump at the bottom with a purge valve, and an inlet coupling. Air from the compressor would pass through the desiccant and the oil removal filters where most of the suspended moisture and oil particles would be removed. The air would then pass into the chamber where it would enter the rest of the air system as dry oil-free air. The water would pass from the desiccant into the sump which contained an electric heating element and a thermostat to prevent the accumulated water in the sump from freezing. A strong spring attached to the purge valve kept it closed normally. When the air reservoir pressure reached the value set on the pressure governor, the purge valve was opened since the spring tension on the valve was set to the same value as the governor. When the purge valve opened, the water in the sump was forcible expelled from the dryer unit by air pressure. After a brief interval, the air pressure in the dryer dropped sufficiently to enable the spring on the purge valve to close the valve. In this manner, most of the moisture and oil was removed from the air supply. (Transit Canada, July-August 1975, pp. 19-20)

A new automatic transmission (torque converter) was supplied with these buses. The new transmission, designated V730, provided three forward speed ranges which enabled a bus equipped with the transmission to travel at highway speeds without excessive engine speed. (Transit Canada, July-August 1975, p. 19)

The new GMC buses were numbered 397 through 399 and 601 through 657. All of the units contained seating for 47 passengers. The buses were delivered during April and May 1976. These buses were painted in the new colors which had been designed for Edmonton Transit (ET).

In early 1976, the name "Edmonton Transit System" was abandoned in favor of the shorter designation "Edmonton Transit". A new color scheme was adopted with the new name. (ETAR, 1976, and Author's Photographs) The portions of the bus above the fluted aluminum panels were painted white in addition to the areas below the panels. The border areas around the windshield were painted black in order to reduce reflected glare. The lower portions of the bus also contained an arrangement of yellow and blue stripes. The blue stripes contained reflective beads for increased night visibility of the bus. The bus number in black was applied directly above the front door and above the operator's window. The number was also centred directly above the rear window. On some buses, the number was also placed at the front of the bus on the manual ventilator cover which was located below the windshield near the left-hand side of the bus. The old ETS crest was replaced by a stylized "E" decal in blue, which was followed by the word "Transit" in black lettering. The new insignia and the lettering were placed on the aluminum panels on both sides of the bus, near the front, while the insignia only was placed on the back of the bus below the rear window. It should be noted that the insignia was reversed on the left-hand side of the bus for esthetic considerations. (Author's Photographs) The blue areas were similar to Pantone ink shade 801+C, while the yellow stripes were similar to Pantone ink shade 824C. (Author's Comparisons using Pantone Matching System Book, 1980)

An additional 40 GMC T6H-5307N buses were ordered during 1976 and arrived in Edmonton before the end of that year. The buses, which were identical to the previous buses received, were numbered 658 through 697. (ETAR, 1979, p. 30; see also Appendix I)

During 1976 and 1977, ET ordered an additional 70 GMC T6H-5307N buses, as well as 18 Flyer Industries model D10240 buses. The GMC buses were identical to the previous order and were numbered 698 through 767. (See Appendix I) Plate 40 (Author's Photograph) depicts bus Number 704 during 1978. The new ET paint scheme as well as the lack of standee windows should be noted.

The 18 Flyer Industries buses were similar to the last order of Flyer buses purchased by the ETS. There were some minor body changes as well as some major mechanical changes with these buses. Very few

Plate 40. (Author's Photograph) Bus Number 704 (2nd)
Trolley Bus Number 247

Plate 41. (Provincial Archives of Alberta) Trolley Bus Number 101
in 1939

LUNCH
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air conditioning units had been sold and many bus operators complained that the triangular housing on the roof of the buses had interfered with bus cleaning operations. Responding to consumer dissatisfaction, Flyer Industries omitted the housing on the new buses and installed curved transition pieces to join the roof with the back of the bus. The double centre exit doors were also modified so that they resembled the exit doors supplied with the GMC buses. (Author's Photographs)

The new Detroit Diesel 6V-71N engines were supplied with these buses as well as the V730 transmission. In addition, the engine was mounted transversely on these buses which eliminated the need to use belts to connect auxiliary apparatus to the engine. In this configuration, the Flyer Industries buses were quite similar, mechanically, to the GMC T6H-5307N buses in the ET fleet. This similarity standardized maintenance procedures among these two makes. (Transit Canada, November-December 1977, p. 12) The new Flyer buses were numbered 841 through 858 and were painted in the new ET colors. (Author's Photographs) It should be noted that the side panels on these buses were also painted white. These units, therefore, did not possess any large unpainted surfaces on the exterior sheathing. (Author's Photographs) Buses 841 through 858 were similar in appearance to the trolley bus which is depicted in Plate 45.

By the end of 1978, ET had ordered an additional 58 GMC T6H-5307N buses which were identical to the previous GMC units received. The buses were numbered 768 through 799 and 900 through 925. (ETAR, 1979, p. 30; see also Appendix I)

Between 1976 and 1979, the City of St. Albert, Alberta which is located to the northwest of Edmonton, began to operate a motorbus service between Edmonton and selected point in St. Albert. The buses, all GMC model T6H-5307N, were maintained, stored and operated by ET personnel. Although the buses were painted in special St. Albert livery, the buses were assigned ET fleet numbers. (See Appendix I) It should be noted that these buses were equipped with standee windows, the new V730 transmission, and special tires that could withstand prolonged high-speed travel. (Author's Photographs and Observations) It should also be noted that the buses purchased by St. Albert in 1979 were manufactured by GMC's new Quebec assembly plant which was located near Montreal, hence the letter "M" as the serial number prefix. (See Appendix I)

During 1977, the County of Strathcona, located to the east of Edmonton, began to provide motorbus service between Edmonton and the Town of Sherwood Park with ten model T6H-5307N GMC buses. (ETAR, 1979, p. 30) The buses were operated in a similar manner to the St. Albert buses and were assigned ET numbers. (See Appendix I)

Equipment Modifications, 1977-1980

As time permitted, ET repainted their older vehicles in the new colors. Vehicles that were due for retirement were not repainted. Before most buses were repainted, however, the old ETS crests were removed and were replaced by adhesive-backed paper which had a small version of the new ET insignia and the word "Transit". In addition, the new numbering was also placed on the buses, even on those units scheduled for imminent retirement. (Author's Photographs) The new numbers were larger than the numbers that they replaced. In addition, the numbers were also located in standard positions which facilitated unit identification.

Many of the older buses were fitted with the electrically-operated roller signs and the passenger stop indicator lamp. These items were usually installed on the buses as they underwent repainting. (Author's Observations)

Between 1970 and 1980, ET reintroduced the use of two-way radios on its buses. It should be recalled that some buses had been equipped with such apparatus during the early 1950's. In conjunction with the new LRT system, ET developed a radio network to facilitate bus and train operations and security. Each bus was equipped with a radio unit and a telephone-like handset. The handset was located above the operator's window inside the bus, while the radio unit was placed behind the operator's seat. A small antenna encased in a plastic dome was installed on the roof of each bus, directly behind the front centre clearance lamps. (Author's Photographs) Buses scheduled for retirement were not equipped with this apparatus. The operators of these units carried portable transceivers instead (walkie-talkies). (Author's Observations, and ETAR, 1979, p. 15)

During this period, some of the older buses were equipped with a Bendix-Westinghouse air dryer in order to eliminate moist air problems. Edmonton Transit also experimented with the use of plastic and pressed steel seats which were similar in construction to the old streetcar-type seats that had been installed on the first SRD motorbuses. The new seats were installed on bus Number 658. (Edmonton Journal, May 30, 1977, p. B14) The new seats were more expensive than the older tubular type and, consequently, their use was soon terminated.

The treadle mats which operated the centre exit doors on many of the newer GMC buses had repeatedly frozen during winter weather. A frozen treadle mat resulted in operational delays as the result of the doors either sticking open or closed. To eliminate this problem, ET experimented with other automatic door actuating devices including electric eyes and moveable gates. In 1979, ET decided to equip the buses with treadle mats with swing gates which would open and close the centre exit doors. (ETAR, 1979, p. 19) A swing gate consisted of a small vertical pipe which was mounted at the side of the stepwell on the bus floor. The pipe was supported by an internal steel shaft which was mounted on a pedestal screwed to the bus floor. The shaft enabled the pipe to revolve around the shaft. A curved piece of plywood, aluminum or masonite was then secured with screws to a casting attached to the top of the pipe. The pipe was connected at the bottom to a moveable electrical contact which closed the door opening circuit when the gate was pushed open by a passenger descending the steps. If the bus was stopped and the operator had set the controls, the exit door would open when the gate was pushed open. When the passengers stepped off the bus, they usually released the gate and a spring located between the shaft and the pipe pulled the gate back to its original position, thus breaking the door control circuit. A delay feature prevented the doors from closing immediately, thus allowing most passengers enough time to step clear of the doors. The gate mechanism was manufactured by the Fred A. McKay Company of Montreal and was invented at the end of the Second World War as a replacement unit for treadle mechanisms on streetcars and buses. (Specifications of Safety Control Gate, 1947) The main advantage of the gate arrangement over the treadle mat was that the gate was not affected by extremely cold weather.

During 1979, ET installed special energy absorbing bumpers on ten of their GMC buses. The bumpers were composed of molded neoprene and were designed to reduce structural damage to the bus during a collision by absorbing most of the impact. (ETAR, 1979, p. 19) This type of bumper, in addition, did not require periodic maintenance like the water bumpers tried several years earlier.

Equipment Disposal, 1978-1981

By early 1978, several longitudinal structural members in the single Western Flyer bus Number 800 had developed cracks. Faced with the spectre of costly repairs, ET decided to sell the unit. (ET Internal Memorandum to O. Kisilevich from L. F. Wiebe, 1978, and ET Notice of Tender, October 1978)

The entire fleet of GMC TDH-5105 buses, purchased between 1955 and 1958, were also retired during 1978. Bus Number 432 was retained by ET for historical purposes, while the remainder were sold to individuals as operating units. (ET Notice of Tender, October 1978)

The operation of school buses owned by ET ceased by 1981. The remaining school buses were sold as operating units. (ET Notice of Tender, 1981, and ETAR, 1982, p. 11)

New Equipment, 1980

During July 1979, City Council approved the purchase of 70 additional GMC model T6H-5307N buses for ET. (ETAR, 1979, p. 19) Thirty of the buses were to have a seating capacity of 49, while the remaining 40 buses were to have a seating capacity of 47. Several new technical features were to be included with some of the buses. Most of the units were to be equipped with energy absorbing bumpers. Forty of the buses were to be fitted with digital destination signs instead of the traditional roller signs. The new signs were installed at the front, side and rear locations. (ETAR, 1979, p. 19) The new signs employed modern electronic circuitry to display both route numbers and destinations, in addition to other messages that could be flashed across the signs at specific intervals.

Thirty of the buses were to be equipped with cloth upholstery as an experiment to determine the feasibility of using such material as a bus seat cover. The new cloth was designed to make the bus seats more comfortable while maintaining some resistance to soiling. (ETAR, 1979, p. 19) The buses were numbered 926 through 995 and were delivered to Edmonton during 1980. (ETAR, 1982, p. 30) Buses 926 through 970 were equipped with digital signs, while buses 926 through 955 were equipped with cloth upholstery. It should be noted that these buses were assembled at the GMC plant in Quebec. (ET Listing of Buses, November 1980)

During 1980, the City of St. Albert purchased an additional three GMC T6H-5307N buses while the County of Strathcona purchased an additional six buses of the same type. (ETAR, 1982, p. 31)

At the end of 1980, ET had in its operating fleet a total of 623 diesel-powered motorbuses, 37 trolley buses, and 17 LRT vehicles. (ETAR, 1982, p. 30) The motorbus, which had once been intended as a feeder vehicle for streetcar lines and (later) trolley bus lines, was not the unquestionable mainstay of Edmonton Transit's passenger fleet. All but 28 of ET's motorbuses were various GMC models. The desire, expressed by Superintendent D. L. MacDonald in December 1964, to standardize the bus fleet to one or two makes had been realized. (Report to the City Commissioners from ETS Superintendent D. L. MacDonald, December 11, 1964, pp. 3-4)

Throughout its 48 year history in Edmonton, many changes have occurred and reoccurred with the motorbus fleet. The initial fleet of gasoline-powered vehicles gave way to diesel engines which, in turn, were replaced by gasoline and propane engines. Diesel fuel, once again, appears to be the most popular fuel for ET buses. The appearance of the vertical exhaust during the early 1940's, its rapid demise and its reappearance as a standard feature on buses during the 1970's, illustrates how technological improvements enabled an old idea to be resurrected with success. Technological regression, however, also occurred. The disastrous Daimler-Duple buses are one such example. Whether the changing technology of the motorbus will enable it to retain its position as the mainstay of the ET fleet remains to be seen in the future.

Chapter VII

Trolley Buses

Introduction

The first serious consideration of the use of trolley buses in Edmonton occurred during 1930 when SRD Superintendent W. J. Cunningham met with heavy equipment supplier H. J. Griswold. Griswold informed Superintendent Cunningham that the trolley bus was replacing streetcars in many urban centres in England because of its versatility and its use of existing street railway electrical apparatus. (Letter to SRD Superintendent W. J. Cunningham from Griswold & Co., June 18, 1930) Trolley buses of that era usually consisted of some sort of steel chassis supported by two or three transverse axles which had rubber-tired wheels attached to each end. A wooden or a steel-framed body was attached to the chassis and locomotion was provided by one or two large direct current electric motors which were mounted on the chassis beneath the body. Current collection was usually by means of two roof mounted trolley poles since the rubber tires and the consequent maneuverability of the bus precluded the use of most conductors located in the road. The electrical control apparatus on most trolley buses was similar to that found on most streetcars of that time, although foot operated controllers were frequently supplied with trolley buses since the operator had to steer the bus as well as control its speed. (Whyte, 1911, pp. 60-63)

Superintendent Cunningham was impressed by the maneuverability of the trolley bus and its economy of operation. In a 1931 report on the future of public transportation in Edmonton, Cunningham stated that he believed that trolley buses could be used in the near future in Edmonton, in order to provide new routes to the newly-developed areas of the City and to replace streetcars on unremunerative lines or on lines in need of expensive track repair. (Canadian Railway and Marine World, November 1931, p. 723) Although the trolley bus was used in England and in various centres in the United States, no Canadian cities were operating trolley buses at that time. (Canadian Transportation, June 1946, p. 321) In addition, no trolley buses were being manufactured in Canada whereas both streetcars and motorbuses were. In order to operate trolley buses, the SRD would have had to import the rolling stock from either Great Britain or the United States. (Wilson & Bunnell, 1938, pp. 12-15) The depressed economic conditions of that time prevented any further consideration of trolley buses by the SRD for several years.

It was mentioned in Chapter III that much of the street railway track in Edmonton was in deplorable condition and in need of immediate and expensive repair by the late 1930's. In a report to the City Council in December 1937, the Commissioners and Superintendent Ferrier of the SRD pointed out that the street railway was, "the only Utility which has no definite rehabilitation program mapped out ahead. This is due in part to lack of resources and also to the doubtful position of bus development" (CECR, December 22, 1937, p. 1). The report also mentioned the introduction of trolley bus operation in Montreal, Quebec and how that operation had resulted in lower maintenance costs and increased revenues. One of the major recommendations in the report was that a competent consultant be hired to evaluate the system and to recommend changes. (CECR, pp. 3-7)

The City Council followed the recommendation and the Toronto, Ontario consulting firm of Wilson and Bunnell was hired. Their report was submitted to the City Council during April 1938. (Wilson & Bunnell, 1938, preface) The report recommended the gradual replacement of streetcar service by trolley buses, since such vehicles were: inexpensive to operate, since they used the existing power supply; noiseless and odorless, unlike motorbuses; able to transport more passengers than motorbuses; equipped with similar electrical apparatus to streetcars and, therefore, streetcar maintenance crews could also work on trolley buses without extensive retraining; and were classified as streetcars, so they would not require motor vehicle licenses as did motorbuses. (Wilson & Bunnell, pp. 13-17) The initial trolley bus route proposed by the report required six trolley buses in order to be operated properly. (Wilson & Bunnell, p. 1) The City Council adopted the report and most of its recommendations and began to consider the type of trolleybuses that would be purchased. (CEAR, 1938, p. 9)

New Equipment, 1938-1942

The introduction to this Chapter noted that the Wilson and Bunnell report of April 1938 recommended the purchase of six trolley buses for Edmonton's initial trolley bus route. The report noted that Montreal had obtained trolley buses of British manufacture for its system but the report did not recommend the use of British buses in Edmonton,

> Much as we would prefer to recommend the purchase of British made machines, we do not think that Edmonton should assume the writing of specifications for vehicles that would be 'orphans' when made . . . . British made trolleybuses are very fine machines, but their standard models do not fit North American operating conditions, and to do so must be specially designed throughout. (p. 14)

It should be noted that most American trolley buses were constructed as single-deck vehicles, while most British made trolley buses were constructed as double-deck units. The trolley buses constructed for Montreal, however, had been single-deck vehicles. (English Electric Co.

Specifications of Model 663T Trolley Bus, 1938)

The SRD began to solicit bids for the six trolley buses in July, and ceased accepting bids at the end of September 1938. (CECR No. 38, October 11, 1938) Commissioner R. J. Gibb and SRD Superintendent Ferrier both analyzed the bids submitted by American as well as British manufacturers. In addition, Superintendent Ferrier travelled to Montreal and to several American cities to view personally trolley bus operation in those centres. His conclusions were that the British built trolley buses in Montreal provided a smoother ride than any American trolley buses because the British vehicles in Montreal were equipped with three axles. No American companies produced three-axle trolley buses at that time. Based upon this criterion and against the advice of the Wilson and Bunnell report, Superintendent Ferrier and the Commissioners, "eliminated all bids except those of the English Electric Company and the Leyland Company which were the only bids submitted on three axle equipment complying with our specified speeds" (CECR No. 38, October 11, 1938).

The City ordered three trolley buses each from the English Electric Company and Leyland Motors Limited. (English Electric Co. Contract for three Model 663T Trolley Buses, October 18, 1938, and Letter to Commissioner R. J. Gibb from Leyland Motors Ltd., December 27, 1938) The general construction of the two makes of trolleybus was similar to the construction of the SRD motorbuses of that period. Each trolley bus consisted of a chassis composed of steel structural members which were riveted and welded together. Unlike the motorbus chassis, each trolley bus chassis was provided with three axles, one near the front, and two near the rear. The purpose of the dual rear axles was to distribute the heavy weight of the motor and the electrical equipment over a large surface. The bodies of both makes were constructed as separate units and were connected to the chassis after it was completed. (English Electric Co. Specifications of Model 663T Trolley Bus, 1938, and Leyland Service Manual for Model TTB Trolley Bus, 1939)

The chassis of the three buses ordered from English Electric were manufactured by the Associated Equipment Company (AEC) of Southall, England, while the bodies and the electrical apparatus were provided by the English Electric Company. The final assembly of the components was done by AEC. (AEC Service and Instruction Book for Model 663T Trolley Bus, 1939) Each of the rear axles contained a worm-drive differential which was located near the left-hand side of the chassis. A steel driveshaft with universal joints at both ends joined the driveshaft to each differential. Leaf spring suspension was used between the axles and the chassis. In addition, small spring shock absorbers were placed near both wheels of the front axle. Air operated drum brakes were also placed at the end of each axle. It should be noted that dual tires were not used on the rear axles. (AEC Service and Instruction Book, 1939)

The motor and the control apparatus were manufactured by English Electric and were installed on the chassis before the body was attached. A single type 408A motor with a maximum output of 115 H.P. (85.8 kW) was installed on each trolley bus. The motors were generally referred to as being of the box-frame, compound wound, self-ventilated type. (English Electric Specifications, 1939) Unlike most streetcar motors used on the SRD which had split frames (cases), these trolley bus motors were contained in one-piece steel cases. Although the case was cast in one piece, the ends could be removed in order to facilitate component removal. The term "compound wound" meant that in addition to field coils, this type of motor possessed another set of coils called shunt coils, which were located in between the field coils. The shunt coils were designed to further control the speed of the motor. The term "self-ventilated" referred to the fact that the armature shaft of this type of motor held a metal fan which drew air into the motor when it was in operation. The air served to cool the motor's windings. (English Electric Co. Specifications, 1938)

The motors on these trolley buses were located near the centre of the chassis and were secured to it with several bolts. Rubber bushings placed on the bolts between the motor case and the chassis were designed to limit the amount of motor vibration transmitted to the chassis. Power was transmitted from the motor to the rear axles through a steel drive shaft. A special type of drum controller, designated KM-805A, was located near the front of the chassis. This controller was designed so that the interior drums were aligned horizontally. The controller was placed so that it was underneath the operator's seat. By aligning the controller in this position, the movement of the power drum (power shaft) could be controlled by a foot pedal connected to levers. (English Electric Specifications, 1938)

It should be recalled that streetcar motorman in Edmonton normally used their left hands to rotate a streetcar controller's power shaft, while their right hand was used to operate the brake valve. (See Chapter V) The SRD had decided to continue this arrangement with the foot pedals on the new trolley buses since it was believed that the operators of the buses would primarily be former streetcar motormen. The foot pedals on these trolley buses, therefore, were arranged so that the left-hand pedal was connected to the controller, while the right-hand pedal controlled the brakes. (Supplement to English Electric Proposal, October 13, 1938) This pedal arrangement later caused confusion since most buses and automobiles in Edmonton had the pedals arranged so that the right pedal controlled acceleration.

The operation of the controller and the motor were somewhat different from the arrangement found on Edmonton's streetcars. The purpose of the controller was still to close and to open various control circuits leading to the motor, thus controlling motor speed. Full trolley current was not passed through the controller during the various controller steps. Upon entering the trolleybus body near the front, the positive cable passed through a ceiling-mounted line breaker. A small diameter cable was then connected between the main cable and the controller. The main cable then proceeded beneath the floor of the trolley bus to a steel cabinet which was attached to the top of the chassis at the rear. This cable was connected to one side of several magnetically operated contactors which were located inside the cabinet. The contactors consisted of a single fixed contact made of heavy copper and a hinged moveable contact, also of heavy copper, which was insulated both from the first contactor and from its steel mount. A heavy coiled spring kept the contacts normally open. A large electromagnet attached below the fixed contact was strong enough to close the contacts when it was energized. A braided copper jumper cable connected the moveable contact with the necessary cable. The braided jumper cable was designed so that it did not interfere with the movement of the moveable contact. The copper contacts were more substantial than the fingers and segments found in most controllers. This rugged construction enabled the contactors to pass large amounts of current without sustaining serious damage. The two contacts were shaped so that they curved away from each other. In addition, the contacts were surrounded by a porcelain arc chute. When the controlling electromagnet was de-energized, the spring rapidly separated the two contacts. When this occurred, an arc was formed between the contacts. The curvature of the contacts, as well as a small electromagnet attached behind the fixed contact, caused the arc to move away from the contacts, thus preventing the arc from remaining on the contacts and melting them. The arc chute diverted the hot arc away from insulated wires and other apparatus that could be burned easily. (English Electric Co. Maintenance Manual, 1939, pp. 20-31)

The contactors were connected to the motor's armature and field coils through various amounts of resistance. As each contactor was closed, the amount of resistance in the circuits leading to the motor was reduced, thereby increasing the motor's speed. (See Chapter V for further information) In addition, other contactors completed a circuit between the positive trolley cable, the shunt fields and the negative trolley cable. The shunt coils were so arranged inside the motor that the magnetic field produced by the shunt coils acted in opposition to the magnetic field produced by the field coils. In this manner, the shunt coils could be used to moderate or reduce the motor's speed. This type of arrangement was necessary for a single motor since the older type of series-parallel control found on two or four motor streetcars could not be used. (English Electric Co. Maintenance Manual, 1939, pp. 20-31)

In normal operation, the operator moved the reverser drum of the controller to the "ahead" position by means of a handle attached to the reverser. The handle was located on the controller case to the left of the operator. When the power pedal was depressed slightly, the controller's power shaft was rotated a short distance. This action caused one of the contactors to close, which provided a circuit to the motor through the maximum amount of resistance. In addition, another contactor was closed which provided full power to the shunt coils. When these actions occurred, the motor's armature began to rotate and the bus began to move. It should be noted that all the current passing through the motor was directed through another cable which led to the negative trolley pole. No current was supposed to reach the negative trolley pole by passing through either the chassis or the body. As the operator depressed the power pedal further, more contactors were closed which reduced the amount of resistance in the circuit leading to the motor. The strength of the shunt fields was maintained. Like the operation of a streetcar controller, a trolley bus controller could not be left in a resistance step. When the power pedal was depressed far enough, the operator felt a discernable notch which indicated that the controller was on a "running" position (all the resistance had been removed from the motor circuits). This running position could be used indefinitely. At this point, the trolley bus motor was rotating at approximately half-speed. (English Electric Co. Maintenance Manual, 1939, pp. 20-31)

In order to further increase motor speed, the shunt field had to be weakened. This was accomplished by inserting resistance in series with the shunt coil circuit. As the operator depressed the power pedal beyond the first running notch, contactors were closed which connected the shunt coils with different resistance grids from those used for the field coils. When the shunt field was eliminated, a second running notch was felt. At this point, the trolley bus was usually travelling at a considerable speed. It should be noted that the rheostat grids on these trolley buses were similar to the rheostats found on most ERR streetcars. The trolley bus rheostats, however, were placed in a steel cabinet which had forced air directed through it. In cold weather, a damper attached to the cabinet diverted the warm air from the cabinet to a duct inside the bus body where it heated the interior. In warm weather when the heat was not required, the damper would be closed and the hot air would be diverted outside the bus. (English Electric Specifications, 1939)

The braking system on these trolleybuses was far more complex than either the streetcar or bus braking systems of that time. When the operator released the power pedal, all power was removed from the motor and the shunt circuits. When the brake pedal was depressed, a small auxiliary drum inside the controller was rotated. This drum closed a contactor which half-energized the shunt field. This action not only slowed the speed of the motor, but also induced electricity into the field coils. This electricity was dissipated as heat through the main rheostats. If the operator depressed the brake pedal further, full power was applied to the shunt coils, which further reduced the motor speed. This braking system was known as "dynamic" or "rheostatic" braking. (English Electric Co. Maintenance Manual, 1939, pp. 6-7) Although dynamic braking was effective in greatly reducing the speed of the bus, it could not bring the vehicle to a complete stop. In order to accomplish this, the air brake system was gradually activated when the operator depressed the brake pedal. As the bus slowed, more air pressure was applied to the brake cylinders by the action of the brake pedal. It should be noted that the controller was equipped with an interlock arrangement which cut power to the motor if the brake pedal was depressed at any time. The interlock also prevented the power pedal from being depressed if any of the doors were open. The entire propulsion and braking system was known as "series dynamic" control, or SD. (English Electric Co. Maintenance Manual, 1939, p. 6-7)

In order to reverse the trolley bus, the operator placed the reverser drum in the "reverse" position. The three AEC-English Electric buses were also equipped with two large 30 volt batteries. In addition to providing power for the body lighting, the batteries could be used to move the bus in the event of a power failure or in the case of a diversion. In order to use battery power for the motor, the operator had to remove the reverser handle from the controller and install it on a changeover switch. When the switch was moved from the "trolley" position to the "battery" position, the batteries were connected in series to a special contactor. When the handle was reinstalled in the controller, the operator could step on a floor mounted plunger switch. This switch closed the contactor which provided a circuit between the batteries and the motor's armature and field coils. The 60 volts produced by the batteries was sufficient to move the bus several blocks at slow speed. A reversal of the procedure enabled the bus to use trolley voltage. (English Electric Specifications, 1938)

In order to keep the batteries fully charged, these buses were equipped with a small motor generator set. The motor operated from trolley voltage and was directly coupled to a 30 volt generator. This apparatus was mounted on the chassis in addition to the batteries. It should be noted that the British electrical codes of that period prohibited the use of trolley voltage for the interior lighting of trolley buses, hence the use of low voltage lighting. (English Electric Specifications, 1938)

A two-cylinder British Westinghouse air compressor was also mounted on the chassis. It was powered by a 3/4 H.P. (0.6 kW) English Electric motor. The air system also contained an alcohol evaporator to prevent suspended moisture in the compressed air from freezing in the air brakes or the door cylinders during cold weather. (English Electric Specifications, 1938)

The chassis was fully assembled and was tested under power before the body was attached. (Photographs of Chassis Testing in Author's

Collection)

The body, which was manufactured at English Electric's body factory in Preston, England, consisted of steel framing which was arc welded together. (Supplement to English Electric Proposal, October 13, 1938) The appearance and construction of the body were similar to the bodies of SRD motorbuses purchased during that time. (See Chapter VI) The flooring, which was raised over the area of the rear wheels, consisted of tongue and groove pine boards. (English Electric Co. Specifications, 1938) The flooring was covered with 3/8 inch (10 mm) thick cork tiles which were glued to the flooring and which were designed to provide insulation on the floor. (Supplement to English Electric Proposal, October 13, 1938) The body was framed for eight windows along the left-hand side and six windows along the right-hand side, in addition to an air operated front door and a treadle operated centre exit door, both fabricated from ash. Most of the side windows could be opened by lowering the upper part of the sash. This design made it difficult for passengers to stick their arms out. A two-piece flat windshield was also provided in addition to a fixed rear window. The external sheathing consisted of steel panels which were screwed to the frame. Water was kept out of the seams by the addition of aluminum molding strips. The interior paneling consisted of this plywood which was painted with enamels after installation. Two louver vents were located near the front of each side above the windows. Additional ventilation was provided by four roof mounted vents placed near the rear of the body. The spaces between the exterior sheathing and the interior paneling were filled with aluminum foil which was intended to act as an insulating material. Aluminum was used instead of felt because aluminum foil was non-combustible, whereas felt could be set on fire by an electrical short-circuit. (English

Electric Specifications, 1938)

The seating, which consisted of tubular cross and longitudinal seats, could accommodate 38 passengers. The seats were upholstered in leather. The interior lighting consisted of 24 ceiling mounted fixtures which were placed in two rows along the length of the body. Each fixture contained a single low voltage incandescent bulb with a bayonet base. (Supplement to English Electric Proposal, October 13, 1938)

The exterior of the body also contained illuminated roller signs at the front and on the right-hand side. The front roller sign was in two separate units. The smaller unit was designed to display route numbers only, while the larger unit was designed to display destinations. The side roller sign could display destinations only. Each windshield half was equipped with an electrically operated horizontal windshield wiper. The device consisted of a rectangular steel frame which was secured to the molding around each windshield section. A shaft with sprockets at both ends was mounted at the top of the frame. A similar shaft and sprocket arrangement was located at the bottom of the frame. A chain was installed which joined the sprockets on each side. Two rubber wiper blades were attached across the chains at an even interval. The blades were placed so that if the sprocket shafts were rotated, the blades would rub down the windshield vertically. A small electric motor attached to the upper sprocket shaft provided the necessary power required to move the wiper blades. This wiper mechanism, although uncommon in Canada, was a common feature found on British buses of that time. (English Electric Co. Specifications, 1938)

Interior heating was provided by hot air obtained from the rheostat cabinet. Supplemental heating was provided by several underseat electrical heaters which were similar in construction and operation to the electric streetcar heaters described in Chapter V. Electric defrosting units were also provided for each windshield section. A length of resistance wire, enclosed by a protective sheet steel cover, was installed adjacent to the bottom of each windshield section. When in operation, the heaters heated the surrounding air which rose along the windshield and melted any frost on the windshield sections. (English Electric Co. Specifications, 1938)

Neither the roof panels or the carlines were strong enough to support the two required trolley bases and poles. In order for the bases to be mounted on the bus, a heavy steel framework was mounted on the roof. The framework was located in front of the centre exit door. The framework was attached to the carlines with bolts and was enclosed with sheet steel panels for esthetic appeal. (English Electric Specifications, 1938, p. 42) Each trolley bus received its power through two roof-mounted poles which were held by trolley bases. The trolley bases were similar in design to the streetcar trolley bases, but were of lighter construction. The trolley bus trolley bases required only two springs to provide the necessary tension to lift the trolley poles to the wires. The bases supplied with these buses were manufactured by the British firm of Brecknell-Willis and were attached to the roof framework through four bolts which were imbedded in porcelain insulation. (AEC Service and Instruction Book, 1939, pp. 14-16) The use of porcelain insulators eliminated the need for a wooden trolley board. Each trolley pole held a swivel harp and shoe at the end opposite the trolley base. These swivel harps and shoes (described in Chapter IV) were manufactured by the American Ohio Brass Company. Ropes were also attached to each swivel harp assembly and were connected to Ohio Brass trolley retrievers which were mounted on the back of the body. (English Electric Specifications, 1938, p. 13)

A trolley retriever was similar in appearance and construction to a trolley catcher. A trolley retriever consisted, basically, of a trolley catcher and an additional spring. When a trolley pole left the overhead wire, the springs on the trolley base would cause the pole to rise rapidly. This action caused two things to occur. Firstly, the second spring inside the retriever would be tensioned. Secondly, the pawls attached to the retriever's drum swung out. When the pawls swung out, they activated a release mechanism which transferred the tension of the second spring to the retriever drum. This action caused the retriever drum to pull on the rope which lowered the trolley pole. As soon as the pole was pulled down several inches (mm), additional pawls swung out from the drum, which prevented the pole from being pulled up again by the trolley base. In this manner, the trolley pole was pulled clear of the overhead wiring. The bus operator could reset the retriever by releasing the tension on the trolley rope and by replacing the pole on the wire. (Ohio Brass Co. Publication K-334) Each bus was also equipped with two steel hooks which were mounted on the roof of the bus. These hooks enabled the trolley poles to be held down when they were not required. The use of Ohio Brass current collection equipment was probably selected by the SRD because the overhead wiring material was obtained from the Canadian Ohio Brass Company. (See Chapter IV)

It should be recalled that streetcar motormen could climb onto the roofs of SRD streetcars by means of small fixed steps which were located at the corners of the car bodies. Access to the roofs of trolley buses were provided by means of several hinged steps which were located on the right-hand side of the body immediately in front of the centre exit door. (Photographs in Author's Collection) Other roof mounted electrical apparatus included two radio interference suppressors which were described briefly in Chapter V. One interference suppressor was connected in series with each trolley pole and consisted of a metal housing which contained an inductor and a capacitor. These components were arranged so that they provided a high impedence. This impedence prevented any spurious electrical pulses produced by any trolley bus electrical apparatus from reaching the overhead wires which acted as antennae. (English Electric Specifications, 1938, p. 17)

Each trolley bus was also equipped with the following: corner clearance lamps, wood-framed storm sashes for the side windows, an interior rear view mirror, an exterior left-hand rear view mirror, a speedometer, an indicator lamp which was extinguished when a trolley pole dewired, an electric horn, an air operated horn which was operated by a large hand operated squeeze bulb, a battery charging plug, a single brake light, a single tail light, and two headlights. It should be noted that in keeping with British practices of that time sealed headlamps were not used. Each headlight housing, instead, contained a concave reflector and two 36 W light bulbs, one for the low beam and the other for the high beam. (English Electric Specifications, 1938) In order to ensure passenger safety from electrical leaks and short circuits, all stanchions were insulated with a rubberized material called "Doverite". In addition, a special plug was provided in the body which enabled shop crews to connect an ammeter. The leads to the plug, which was referred to as a "multiple test socket", were connected to the various electrical items in the trolley bus, such as the motor. An additional lead was attached to the body. The ammeter would normally record zero, or a very low current flow, between the electrical apparatus and the body, since both the positive and the negative wiring was supposed to be isolated from the chassis and the body. A high current reading meant that there was an electrical fault which posed a danger to passengers since they could complete a circuit to ground while boarding or alighting from the bus. (English Electric Specifications, 1938, p. 25)

The SRD expressed a concern about tire traction during the winter months since these trolley buses were to be used on a route with several steep grades. Air operated sanders, similar to those applied to many SRD streetcars, were installed on each trolley bus. The sanding apparatus, manufactured by British Westinghouse, consisted of two sanding bins and two operating levers which were placed on the dash of each but to the right of the operator. Each sand bin was located between the two rear wheels on either side of the bus. The bins were placed beneath the seats at those locations. The discharge pipes were placed so that sand could be deposited either in front of or behind each rear wheel. Each operating lever enabled sand to be deposited either in front of or behind each rear wheel, depending upon which lever was depressed. (Supplement to English Electric Proposal, October 13, 1938, and Air Brakes for Electric Trolley Buses, 1931)

After final assembly, the buses were painted in the SRD bus colors of that time. (See Chapter VI) The areas above the bottoms of the windows were painted ivory. An orange band, approximately 6 inches (152 mm) wide and bordered on either side with thin black stripes, was placed immediately below the ivory. The areas below the lower black stripe were painted dark red. In addition, the molding strip which separated the sides from the roof was also painted black. (Color Photographs by H. Hollingworth) An AEC-English Electric Crest was also affixed to the front of each bus. The number, in gold lettering, was applied to the front and to the rear of the bus. The three AEC-English Electric (EE) buses were numbered 101 through 103. These units were shipped to Canada by freighter and then transported to Edmonton by rail. The buses arrived in Edmonton during September 1939. (Letter to the City Commissioners from Gorman's Ltd., September 9, 1939; see also Appendix I) Plate 41 (Provincial Archives of Alberta) depicts trolley bus Number 101 on Jasper Avenue during late 1939. The following should be noted: horizontal windshield wipers, side vents, trolley base support framework, and folding steps near the centre exit door.

The other three trolley buses, which were manufactured by Leyland Motors, were very similar to the AEC-EE buses. The chassis of the Leyland units were manufactured by Leyland, while the bodies were manufactured by the Park Royal Coach Works of London. (Letter to the City Commissioners from J. F. Simpson, August 17, 1939) The electrical apparatus was supplied by the British General Electric Company (GEC). (Letter to Commissioner R. J. Gibb from Leyland Motors Ltd., May 20, 1939) The general arrangement of the chassis was similar to the AEC chassis. Propulsion was provided by a single GEC type WT 265 motor which, at a maximum output of 135 H.P. (100.7 kW) was more powerful than the EE 408A motors supplied with buses 101 through 103. (See Appendix I) The operation of the GEC motor was similar to the operation of the EE motors. It should be noted that the GEC motors used a metal ribbon rheostat rather than the traditional cast metal grid. (Letter to GEC from D. L. MacDonald, October 27, 1947) The air compressor and the sanding equipment were provided by British Westinghouse. (Leyland Specifications of Model TTB Trolley Bus, 1938) It should be noted that the low voltage system and the batteries were designed to operate at 12 volts, not at the higher 30 volts on the AEC-EE buses. In addition, a motor generator set was not used on the Leyland buses. Instead, the generator was driven by a belt connected to the shaft of the main motor. In this arrangement, the batteries were charged only when the bus was travelling at speeds greater than 5.5 miles per hour (8.9 km/h). (Letter to F. J. Simpson from Leyland Motors Ltd., February 13, 1940, pp. 1-2) Leyland's use of this arrangement meant that there was no interchangeability of electrical components between the two makes of British trolley buses in the SRD fleet.

The Park Royal bodies were similar in appearance to the EE bodies and could also seat 38 passengers. Park Royal, however, sheathed their bodies with sheet aluminum which reduced the weight of the body. Six roof mounted air vents were installed in lieu of any side vents above the windows. Small air intake louvers were provided between the tops of the windshield sections and the bottom of the roller sign assembly. It should be noted that these bodies were not equipped with any side roller sign. (Photographs in Provincial Archives of Alberta) In addition to aluminum foil insulation, granulated cork was glued to the interior surfaces of the external sheathing. The cork reduced panel vibration as well as increasing the insulation. The Park Royal bodies were also equipped with most of the items listed for the EE bodies. (Canadian Transportation, August 1939, pp. 410-411) The Leyland trolley buses were also equipped with: a right-hand rear view mirror, metal-framed storm sashes, interior buzzer system, and electrically operated defroster fans for the windshields. Windshield heaters were not supplied with these trolley buses. (Photographs in Provincial Archives of Alberta)

The buses were painted in the same manner as the AEC-EE trolley buses except that the top of the roofs were painted aluminum. (Color Photographs by H. Hollingworth) These buses were numbered 104 through 106. (Letter to Commissioner R. J. Gibb from Leyland Motors Ltd., May 31, 1939; see also Appendix I)

The trolley bus operation proved popular and the City decided to expand the operation. In November 1939, the City decided to order three additional trolley buses, two from AEC-EE and one from Leyland Motors Limited. (Quotation for Trolley Buses from AEC-EE and Leyland Motors Ltd., November 1939) The Second World War had begun by this time and AEC-EE was unable to construct any trolley buses on account of its required war production. The entire order of three trolley buses was placed with Leyland Motors. (Letter to Commissioner R. J. Gibb from Leyland Motors Ltd., April 18, 1941)

Leyland, however, could not begin the construction of these trolley bus chassis until November 1941 because of required war production and because there was an order for several trolley buses for Durban, South Africa ahead of Edmonton's order. (Letter to Commissioner R. J. Gibb from Leyland Motors Ltd., December 20, 1940, and November 11, 1941)

The three trolley buses were to be similar to the three Leyland trolley buses already owned by the SRD. There were to be some mechanical changes, however. The SRD had found that the battery charging arrangement on the first three Leyland trolley buses was unsatisfactory. A larger generator unit or a motor generator set was to be supplied with the new trolley buses. Leyland, however, was unable to obtain 12 volt generators of any sort so they supplied a large 24 volt generator instead. Edmonton had also discovered that the leaf springs on buses 104 through 106 were prone to breakage. Heavier springs were specified for the new trolley buses. (Letter to J. F. Simpson from Leyland Motors Ltd., February 13, 1940)

Leyland buses 104 through 106 did not possess side roller signs or hand rails above the longitudinal seats. These items were to be supplied with the new trolley buses. (Letter to Commissioner R. J. Gibb from

Leyland Motors Ltd., April 18, 1941)

The buses were completed by the end of June 1942 and were shipped to Canada in special convoys during July. Upon their arrival in Canada, the trolley buses were transferred to railroad flatcars which were brought to Edmonton. (Letters to Commissioner R. J. Gibb from Leyland Motors Ltd., July 2, July 10 and July 27, 1942, and Letter to SRD Superintendent T. Ferrier from Waterous Limited, August 18, 1942)

The three trolley buses could not be painted in the appropriate colors in Britain so they were shipped to Canada painted in a grey primer only. These buses were painted and numbered when they reached Edmonton. (Photographs in Corness Collection, and Letter to J. F. Simpson from Commissioner R. J. Gibb, October 16, 1942) The three trolley buses were painted to match the three other Leyland trolley buses in Edmonton. The new trolley buses were numbered 107 through 109. (Photographs in Provincial Archives of Alberta; see also Appendix I)

Equipment Modifications, 1939-1942

Soon after placing the British trolley buses in service, the SRD experienced serious operational problems with them. It was discovered that the motors on the three AEC-EE trolley buses were too small to adequately propel the buses up the steep grades found on the initial trolley bus route. When the buses were loaded and tried to ascend these steep grades, one or more field coils burned out. In order to prevent this action from occurring, the three AEC-EE trolley buses were transferred to another trolley bus route that did not possess any steep grades. (Ferrier, 1946, p. 19)

Problems were experienced with stiff parts during cold weather. This problem existed because the lubricants originally supplied with these trolley buses were not designed for extreme cold weather use. Different, less viscous lubricants solved this problem. It was also discovered that the tires supplied with the trolley buses were of slightly different dimensions than tires available in Canada. If tires of different sizes were mounted on the same rear axle, the differential would overheat and would usually result in the failure of the differential. If this occurred, an expensive repair resulted. The SRD endeavoured to overcome this problem by matching the tires on each rear axle. In addition, the extreme cold weather in Edmonton had caused some of the differentials to seize because the metal parts inside the housing contracted and bound against each other. To overcome this condition, the SRD machined the differential housings and inserted a thin brass washer between the housing and the worm gear. The washer was flexible enough to permit some cold weather contraction within the differential without seizing. (Ferrier, p. 19)

Problems were also experienced with the battery charging system on the first three Leyland trolley buses. It was mentioned in the previous section that the 12 volt generators on those buses were inadequate for keeping the batteries sufficiently charged. In many instances, the bus lighting became so dim that the bus could not be operated safely. (Letter to F. J. Simpson from Leyland Motors Ltd., February 13, 1940) It was also mentioned that larger 24 volt generators were supplied with the three additional Leyland trolley buses. During 1941, Leyland Motors shipped a number of the new 24 volt generators to Canada as replacements for the original 12 volt units. That batch of generators never reached Canada because they were lost at sea as the result of enemy action. New generators eventually reached Edmonton during 1942. In the interim, the SRD had removed several interior lights on the Leyland trolley buses in order to conserve battery energy. (Letter to Commissioner R. J. Gibb from Leyland Motors Ltd., April 27, 1942) During this period, heavier leaf springs were also sent to Edmonton for the first three Leyland trolley buses. (Letter to F. J. Simpson from Leyland Motors Ltd., February 13, 1942)

Although the British trolley buses functioned, they experienced some technical problems. In addition, it had been found that the motors in the AEC-EE buses were not powerful enough for Edmonton's terrain. It had also been discovered that it was extremely difficult to obtain parts for these vehicles, a problem that the Wilson and Bunnell report cautioned the SRD about.

New Equipment, 1943

By early 1942, the SRD was experiencing extremely heavy ridership on most streetcar and bus routes. Additional trolley buses were required in order for the SRD to accommodate such increases in ridership. In early 1942, the three Leyland trolley buses (107-109) had not yet arrived so the Commissioners and the SRD investigated the possibility of obtaining additional trolley buses from American suppliers.

During 1938, the Winnipeg Electric Company had started trolley bus service in Winnipeg with several trolley buses manufactured by the Mack Manufacturing Company of Allentown, Pennsylvania. (Canadian Transportation, June 1946, p. 321) The Winnipeg Electric Company had been able to order an additional five such trolley buses early in 1942. (Canadian Transportation, February 1943, p. 37) Commissioner Gibb was able to convince the federal Transit Controller to allow the City to order three such Mack trolley buses since Winnipeg had received permission to purchase such vehicles. (CECR No. 17, May 26, 1942)

The Mack trolley buses were designated model CR and were substantially different from the British trolley buses operating in Edmonton. The Mack units employed an integral chassis and a body design which was similar to many post-war motorbuses purchased by the ETS. The Second World War had ensured that certain strategic materials were in short supply for civilian construction purposes. Two such materials were aluminum and rubber. Because of the restrictions, these Mack trolley buses used steel sheathing where aluminum had been used in the past. (Mack Specification of Model CR Trolley Coach for the City of Edmonton, 1942) The overall length of the framework and the body, not including the bumpers, was 34 feet 5½ inches (10 503 mm). The framework consisted of various sizes of high tensile steel channels which were arc welded together, no rivets being used. It was believed that by using welded joints instead of rivets, the framework of the bus would be stronger and less liable to weakening at the joints. (Mack Specifications, p. 2) The flooring, which was flat except for semi-circular enclosures around the two rear wheels, was composed of 3/4 inch (19 mm) thick waterproof plywood which was painted with a fire-resistant enamel that contained anti-vermin chemicals. The floor covering consisted of green linoleum under the seat areas and brown ribbed linoleum in the aisle areas. The interior wainscoating consisted of masonite panels, while the ceiling consisted of 20 gauge sheet steel panels which were screwed to the carlines. The external sheathing consisted of 18 gauge sheet steel, except for the roof. Most of the exterior panels had a 2 inch (51 mm) thick layer of felt glued to the interior surface for insulaltion and sound-deadening purposes. Most of the roof was covered with 20 gauge sheet steel except the support area for the trolley bases. The trolley bases were placed on a canvas covered plywood platform which was fastened directly to the carlines. Steel molding pieces around the board prevented moisture from entering the bus. (Mack Specifications, pp. 2-3)

The framework and the body was supported by two axles instead of the three axle arrangement found on the British trolley buses. The rear axle possessed dual tires on each end in order to distribute the weight over a greater surface. The rear axle also possessed a differential that employed a system of dual reduction gearing to transmit torque from the motor to the rear wheels. The driveshaft of the differential was connected to a countershaft situated at right angles to it by means of spiral bevel gears. The countershaft also held a small diameter spur gear (pinion). The pinion engaged a large diameter spur gear which was connected to the axle rods. In this manner, the speed of the motor was reduced by means of the gears before it was transmitted to the axle rods and the wheels. Both the front and the rear axle were supported by leaf springs in addition to hydraulic shock absorbers on each axle. The electric motor was mounted longitudinally at the extreme rear of the underframing. A driveshaft connected the motor with the differential. (Mack Maintenance Manual for Model CR Trolley Coaches, 1942, pp. 706-709)

The interior seating consisted of a combination of tubular cross and longitudinal seats. The seats were upholstered in buffed green leather. The seat backs and the upper framing consisted of plywood and wood pieces since the aluminum normally used for these parts was not available. The stanchions supplied consisted of wooden doweling, while the supports consisted of steel stampings. The seating was arranged to accommodate 40 passengers. Both the front and the centre exit doors were fabricated from wood. The rubber edges on the centre exit doors contained taut steel wires which were attached to a switch inside the door mechanism compartment. The switch was attached to a circuit that controlled the activation of the opening magnet valve. If a passenger stepped off the treadle and was not clear of the door, the wires inside the rubber edges would be deflected, causing the magnet valve to be opened, which reopened the centre exit door. This feature, called a "sensitive edge", prevented passengers from being injured by the closing doors or from being dragged by the bus after the doors closed. (Mack Specifications, 1942, pp. 5-7)

The electric motor and the control equipment for these buses was provided by the General Electric Company of Schenectady, New York. The main motor, designated type 1213D7, was a compound wound, self ventilating motor that could produce a maximum of 140 H.P. (104.4 kW). The control equipment, designated "MRC", was mounted in a compartment located at the rear of the bus above the main motor. The term "MRC" stood for Magnetic Remote Control. (Thompson, 1940, p. 159) The controller supplied with each bus was not located in the bus interior but was located in a compartment placed behind the front axle. This controller, type 17KC48, was an automatic accelerating cam controller. (General Electric Co. Instructions GEI-17030, 1942, pp. 7-9)

Although the operation of the motor and the contactors were similar to the motors on the British trolley buses, the operation of the General Electric controller was somewhat different. Upon entering the space between the sheathing and the interior paneling, the positive trolley cable branched off to the controller before continuing to a magnetically-closed line breaker on its way to the contactor cabinet. The line breaker was controlled by the actions of the controller. The controller consisted of two horizontally aligned shafts which were formed with several cam lobes. The main camshaft had a notched wheel attached to one end and a large spring and a lever attached to the other end. A small ratchet tooth called a "latch" was positioned against the notched wheel. The latch enabled the camshaft to rotate counterclockwise only. The latch, in turn, was hinged and was attached to levers that completed electrical circuits or were moved by the action of various electromagnets. The lever at the opposite end of the camshaft was connected to rods and other levers which led to the power pedal, which was placed to the right of the brake pedal on these buses. This pedal arrangement was in keeping with standard North American automotive practice. A strong spring connected to the power pedal kept it in the "up" position normally. The other camshaft, which was smaller, was connected to a rod which was attached to the brake pedal. Both camshafts had several small "fingers" installed above them. Small springs attached to each finger ensured that each rested on a cam lobe. As the camshaft was rotated, the lobes ended at specific intervals. When a cam lobe ended, the finger resting on the lobe would be permitted to drop. The fingers dropped onto contact bars which completed circuits to the contactors in the contactor cabinet. Small rollers attached to each finger reduced the friction between the cam lobes and the fingers. (General Electric Co. Instructions GEI-17030, pp. 7-9)

The movement of the main camshaft was partially controlled by power pedal movement. When the operator wished to proceed, he (or she) had to ensure that the reverser lever in the operator's compartment was in the "forward" position. This lever was connected by rods to the reverser inside the controller. When the operator depressed the power pedal, several events occurred. The main camshaft of the controller was rotated clockwise until it was stopped by the latch on the first notch of the notched wheel. The pressure of the wheel against the latch caused the latch to pivot slightly. This action closed a contact which completed a circuit to the line breaker which, in turn, energized certain contactors in the contactor cabinet. In addition, as the camshaft rotated, a finger dropped onto a contact which closed one of the contactors in the contactor cabinet. This circuit provided power to the motor's armature and field coils through the maximum resistance. Some of this current was also diverted through a small electromagnet mounted on the controller which acted in opposition to another electromagnet which was part of the controlling circuit to the line breaker. A small contactor was located above the two electromagnets. This arrangement was called the "accelerating relay". The small contactor was not activated at this time because the magnetic field of the electromagnet connected to the motor circuit was stronger than the field of the other electromagnet because of the large current flow through the motor circuit. As the motor increased its speed, the magnetic field surrounding the motor electromagnet in the accelerating relay became progressively weaker because the motor drew less current than before. When this occurred, the field surrounding the other electromagnet in the accelerating relay became strong enough to cause the accelerating relay contactor to close. This action could only take place, however, if the operator kept foot pressure on the power pedal. If pressure on the power pedal was being maintained, the closing of the accelerating relay completed a circuit through an electromagnet which was designed to pivot the latch away from the notched wheel. When this action took place, the latch was pulled back momentarily, since the action of pulling the latch back also broke the circuit to the electromagnet which held the accelerating relay closed. In the instant that the latch was pulled back, the camshaft was allowed to rotate to the next notch on the notched wheel. (General Electric Co. Instructions

GEI-17030, pp. 7-10)

As long as the power pedal was depressed, this procedure continued. The controller was designed so that it did not dwell on any resistance notches longer than necessary. When the operator released foot pressure on the power pedal, the camshaft would be rotated counterclockwise by the action of the return spring until it reached the position determined by the position of the power pedal, or until the camshaft reached the "off" position. In the "off" position, the line breaker was opened and all power to the motor and shunt circuits was cut off. In braking, a slight pressure on the brake pedal caused the brake camshaft to rotate, closing the line breaker circuit and which closed contactors which energized the shunt coils. In addition, other contactors were closed which connected the motor's armature and its field coils to the trolley cables. The voltage induced into the field coils by the action of the shunt field was higher than the trolley voltage so power was sent into the trolley cables. This form of braking was known as "regenerative braking" since the motor acted as a generator during part of the braking sequence. If the operator depressed the brake pedal further, air braking was blended with additional regenerative braking. As the trolley bus slowed down, the regenerative braking was reduced while the air braking was increased. In this manner, a smooth stop was obtained. It should be noted that this type of equipment had no provision for battery propulsion of the main motor. (General Electric Co. Instructions GEI-17030, pp. 7-10)

The air compressor supplied with these buses was a General Electric type CP-37 compressor. This was a two-cylinder compressor that had been specifically designed for trolley bus service. The compressed air from the compressor was passed through a 4 foot (1 219 mm) length of finned copper tubing before it entered the first air reservoir. The purpose of the tubing was to cool the air heated during compression so that it would drop most of its condensate in the first reservoir. Another length of finned copper tubing joined the first reservoir to a second in order to reduce further the moisture content of the air. An alcohol evaporator installed in the system further reduced the risk of moisture freezing in the system. It should be noted that the General Electric equipment did not include sanding equipment. (Mack Specifications, p. 14)

The trolley bases supplied with these buses were manufactured in the United States by the Ohio Brass Company. Their form 11T trolley base was readily available and was considered superior to the British trolley bases because of the use of needle bearings and roller bearings in all moveable joints. (Mack Specifications, p. 11, and Ohio Brass Co. Publication K-361) The trolley bases were secured to a thick board which was attached to the canvas-covered roof section. The bottoms of the trolley bases were covered by a sheet steel cowling which had been fabricated of sheet aluminum before the Second World War. (Mack Specifications, 1942, pp. 11-12) While Ohio Brass harps, shoes and poles were used, Ohio Brass trolley retrievers were not used. The SRD had discovered that the Ohio Brass retrievers had a large number of moveable parts which made that type of retriever extremely difficult to repair. Retrievers manufactured by the Earll Company of York, Pennsylvania were supplied instead. (Mack Specifications, p. 12) It should be recalled that the ERR, in 1915, had selected Earll trolley catchers for its streetcars. (See Chapter V) The trolley pole hold-down hooks were mounted on insulators on these buses as an added safety feature. (Mack Specifications, p. 12)

Interior heating was provided by the rheostats as well as by a number of electric heaters which were also located in the rheostat cabinet. Air for the cabinet was drawn from the outside through two louver vents which were located in the sides of the bus near the rear. An electric blower unit inside the cabinet constantly moved air through it in order to keep the rheostats cool. The hot air from the cabinet could be distributed through the interior of the trolley bus by floor ducts on either side when the thermostatically-controlled damper permitted. Windshield defrosting was accomplished by means of two small compressed air operated fans. Interior ventilation was provided by the windows in addition to four roof-mounted vents and two hinged vents located above the headlights at the front of the bus. (Mack Specifications, p. 8)

The interior lighting of these buses was similar to that found on the British trolley buses. Power for the lights was provided by a small 12 volt motor generator set which charged a small 12 volt battery. Two dual filament sealed beam headlights were provided with each bus as well. (Mack Specifications, p. 10) Two air operated windshield wipers of the vertical oscillating type were installed on each bus. (Mack Specifications, p. 8 & p. 10)

Each bus was painted in the SRD colors but without the orange band and the black stripes. This paint scheme, therefore, moved the ivory areas below the bottoms of the windows. Each bus was numbered on the front and the rear only. (Mack Photographs CR-1277-143V6203 to CR-1277-143V6206) The trolley buses were numbered 110 through 112 and were shipped to Edmonton late in January 1943 and arrived in Edmonton during February. (Telegram to Commissioner R. J. Gibb from Mack Manufacturing Co., January 26, 1943) Plate 42 (Glenbow Archives) shows trolley bus Number 112 on Jasper Avenue during 1943. The different body shape as compared to the AEC-EE trolley bus in Plate 41, Plate 42. (Glenbow Archives) Trolley Bus Number 112 in 1943

Plate 43. (Provincial Archives of Alberta) Trolley Bus Number 119

TRAVEL BY BUS
UNION BUS DEPOT

as well as the single rear axle, vertical windshield wipers, the lack of a steel framework for the trolley bases and the plain paint scheme should be noted.

New Equipment, 1944-1945

The need for additional trolley buses continued despite the arrival of the three Mack trolley buses. By this time, the Canadian Transit Controller had jurisdiction over what equipment civilian transportation systems could purchase. In addition, the American War Production Board had restricted the production of trolley buses to only one manufacturer, the Pullman-Standard Car Manufacturing Company of Worcester, Massachusetts. In spite of these difficulties, the SRD was able to order eight Pullman-Standard trolley buses in early August 1943. (Telegram to Transit Controller G. S. Grey from Commissioner R. J. Gibb, August 3, 1943)

The construction of these buses was similar to the construction of the Mack trolley buses. The Pullman-Standard units, model 41CS-100-44CX, were somewhat longer than the Mack trolley buses because the Pullman-Standard units possessed a long overhang beyond the front axle which enabled these trolley buses to be equipped with double-width front doors. Each door was provided with its own operating cylinder and could be opened independently of the other. (Pullman-Standard Co. Specifications, 1944) The double-width front doors were designed to speed the loading and the unloading of passengers. The exterior sheathing on these trolley buses below the windows consisted of steel panels with horizontal ribs in them for additional panel strength. In most other respects, the interior and exterior appointments on the Pullman-Standard trolley buses were similar to those on the Mack trolley buses. There were several differences, however. The seats and the stanchions were all composed of steel instead of wood, which had been used on the Mack units. The seating on the Pullman-Standard buses was arranged to accommodate 44 passengers. It should be noted that every metal stanchion was insulated from its base as an added protection from electric shock. The air intake for the rheostat cabinet consisted of a low flat air scoop located on top of the roof near the rear of the bus. This design of air intake was intended to provide a positive air pressure to the heating system but it also permitted large amounts of snow to enter as well. (See Plate 43)

The SRD had been pleased and satisfied with the operation of the General Electric motors and control equipment on their Mack trolley buses and specified that the same apparatus be supplied with the Pullman-Standard trolley buses. (Letter from General Electric Co. to the City Commissioners, September 22, 1943, and Pullman-Standard Co. Specifications, 1944) General Electric had modified their MRC control equipment slightly so that dynamic braking was used instead of regenerative braking. (Letter to Gorman's Ltd. from Commissioner R. J. Gibb, August 29, 1944) Dynamic braking was used because General Electric had received complaints from several trolley bus operators that regenerative braking had been damaging the older types of motor generators located in power plants and substations. (General Electric Co. Instructions GEI-17030, 1942) In addition, the controller was mounted in the contactor cabinet at the rear of the trolley bus. (Photographs in Author's Collection)

Westinghouse air brake equipment was supplied with these buses in addition to sanding equipment which could deposit sand in front of each rear wheelset. (Pullman-Standard Co. Specificlations, 1944, and Letter to Gorman's Ltd. from Commissioner R. J. Gibb, August 29, 1944) The air compressor supplied was a type DH-10 two cylinder unit which was similar in design to the GE CP-37 compressor. (Pullman-Standard Co. Specifications, 1944) The sanding equipment was probably installed on these buses because it was available from Westinghouse, whereas such equipment had not been available from General Electric for the Mack trolley buses.

Two Ohio Brass form 11T trolley bases were installed on each bus. In order to increase the longevity of the canvas-covered roof section, each trolley base was mounted on a 1 3/4 inch (44 mm) thick yellow pine board which was attached to the mounting base with insulated studs. In this manner, the trolley bases were supported several inches (mm) above the roof. (Pullman-Standard Specifications, 1944) The remainder of the current collection apparatus was the same as that supplied with the Mack trolley buses.

The Pullman-Standard buses were painted in a similar fashion to the Mack trolley buses except that two thin black stripes were added. One stripe separated the red areas from the ivory areas while the second stripe ran along the tops of the side windows and angled down at both the front and the rear of the bus. (Photographs in City of Edmonton Archives) The eight trolley buses were numbered 113 through 120 and were delivered to Edmonton during July 1944, almost one full year after they had been ordered. (Letter to Pullman-Standard Car Mfg. Co. from Commissioner R. J. Gibb, August 14, 1944) Plate 43 (Provincial Archives of Alberta) shows the left-hand side and the rear of Pullman-Standard trolley bus Number 119 at one point during 1944 or 1945. The following should be noted: rear air scoop, trolley base board, radio suppression coils, Earll trolley retrievers and the trolley pole hold-down hooks.

During early 1944, the SRD determined that it required an additional eight trolley buses in the near future. Permission for the purchase was secured from the Transit Controller and the eight trolley buses were ordered from Pullman-Standard during June 1944, since that company was the only manufacturer authorized to construct trolley buses at that time. (Letter to Commissioner R. J. Gibb from Pullman-Standard Car Mfg. Co., June 9, 1944) The trolley buses were supposed to be "exact duplicates in every respect to the eight (8) trolley buses being furnished on the City of Edmonton order No. 4052 . . . [1943]" (Letter to Commissioner R. J. Gibb from Pullman-Standard Car Mfg. Co., June 9, 1944). Wartime availability of certain parts and materials did not permit this, however.

Canvas had become a restricted commodity so the roofs of these buses had to be sheathed entirely with steel panels. Pullman-Standard did not foresee any difficulties with this arrangement since the trolley bases had not been directly supported by the wooden section on the first eight units. (Letter to Commissioner R. J. Gibb from Pullman-Standard Car Mfg. Co., September 29, 1944) The General Electric Company was unable to supply the same type of blower motor that had been supplied with the first eight Pullman-Standard trolley buses so a larger motor was supplied. (Letter to Commissioner R. J. Gibb from Pullman-Standard Car Mfg. Co., July 12, 1944) The steel-framed sashes that had been supplied with buses 113 through 120 were no longer available. The only sashes that were available were of similar design but were composed of extruded aluminum. Because of these changes, these eight Pullman-Standard buses were designated model 44AS-100-44CX. (Letter to Commissioner R. J. Gibb from Pullman-Standard Car Mfg. Co., August 3, 1944)

The eight buses were painted in the same way as the first buses but were numbered 121 through 128. (See Appendix I) Production difficulties delayed delivery of these buses until August and September 1945.

(Letter to Commissioner R. J. Gibb from Pullman-Standard Car Mfg. Co., July 27, 1945; see also Appendix I)

The SRD believed that it required additional trolley buses for 1945; and in December 1944, the City Commissioners approached the Transit Controller for permission to order further units. It should be noted that by the beginning of 1945, it appeared as if the war in Europe would soon be ending. With this prospect, the American War Production Board had enabled another company, ACF-Brill Motors of Philadelphia, Pennsylvania, to manufacture trolley buses as well as Pullman-Standard. In reply to Edmonton's request, the Transit Controller reported that ACF-Brill Motors was considering having its type of trolley buses manufactured in Canada by the Canadian Car and Foundry Company. In view of this development, the Transit Controller stated that he would authorize the purchase of two trolley buses from either Pullman-Standard or ACF-Brill Motors. (Letter to Commissioner R. J. Gibb from Transit Controller G. S. Grey, January 9, 1945) In response to the Transit Controller's information about future Canadian made trolley buses, the City decided to purchase two ACF-Brill trolley buses since it was believed that such buses would be quite similar to the future Canadian-built units. Permission for the purchase was obtained by the end of January 1945. (Letter to Commissioner R. J. Gibb from Transit Controller G. S. Grey, January 2, 1945) By the middle of March, the City had placed the order for the two trolley buses with ACF-Brill Motors. (Letter to Commissioner R. J. Gibb from ACF-Brill Motors Co., March 16, 1945)

The two trolley buses were designated model TC-44 and were similar in appearance and construction to the three Mack trolley buses, Numbers 110 through 112. The TC-44 trolley buses were larger and could, therefore, seat 44 passengers. (Letter to Commissioner R. J. Gibb from

ACF-Brill Motors Co., March 16, 1945) While the general construction of these trolley buses was similar to that of the Mack and the Pullman-Standard buses described previously, aluminum structural members were used for several side supports as well as sheet aluminum for the external sheathing along the sides of each trolley bus. The use of aluminum reduced the weight of these buses so that they weighed less than the Pullman-Standard buses. Like the last order of Pullman-Standard trolley buses, the canvas-covered roof section had to be dispensed with because of the unavailability of canvas. (Letter to Commissioner R. J. Gibb from ACF-Brill Motors Co., March 16, 1945, and Specifications for ACF-Brill Model TC-44 Trolley Coach, January 1945; see also Appendix I) Unlike the Pullman-Standard trolley buses, the TC-44 trolley buses did not contain double-width front doors. In addition, the heating ducts were arranged so that the heated air entered the interior ducts at the centre of the bus in order to provide a more even distribution of heated air. Windshield defrosting was accomplished by an electric heater and an operator controlled electrically driven fan which were located behind a dash panel.

The General Electric Company provided the electrical apparatus as well as the air brake equipment. Sanding equipment was not provided with these buses. Improvements to the MRC control permitted both regenerative and dynamic braking when the brake pedal was depressed. (Letter to Commissioner R. J. Gibb from ACF-Brill Motors Co., March 16, 1945) With this arrangement, some regenerative power could be produced without causing serious damage to substation and power plant equipment. The placement of the controller and the contactors was in a cabinet located along the left-hand side of the bus. This placement was thought to provide easier pedal operation since the control rods would be shorter. (Letter to Commissioner R. J. Gibb from ACF-Brill Motors

Co., March 16, 1945) It should also be noted that from this point to the present, no Edmonton trolley buses have been purchased with sanding equipment. Lack of availability of such equipment combined with the introduction of road sanding vehicles probably contributed to the demise of individual sanding equipments on trolley buses in Edmonton.

The old style GE CP-37 air compressor was no longer available so the TC-44 trolley buses were equipped with a smaller type CP-25 compressor. (Letter to Commissioner R. J. Gibb from ACF-Brill Motors Co., March 16, 1945)

The buses were painted in a similar fashion to the Mack trolley buses but were numbered 129 and 130. The two units arrived in Edmonton during November 1945. (Letter to Commissioner R. J. Gibb from ACF-Brill Motors Co., November 2, 1945)

New Equipment, 1946-1947

On September 30, 1945, the Federal Government revoked the power of the Transit Controller, enabling urban transportation systems to order any equipment they desired. (Letter to Commissioner R. J. Gibb from Transit Controller G. S. Grey, September 13, 1945) In early October, the City placed an order with Canadian Car and Foundry for 22 of the new 44 passenger Brill trolley buses that were to be manufactured in Canada. (Letter to Canadian Car & Foundry Co. from Commissioner R. J. Gibb, October 10, 1945) Canadian Car and Foundry, unfortunately, could not begin work on these units since it had not yet completed the specifications for the trolley buses and was just beginning to manufacture the new model C-36 motorbuses. (Memorandum to SRD Superintendent T. Ferrier from Commissioner R. J. Gibb, September 27, 1945)

The specifications for the new trolley buses were completed during

February 1946. (Canadian Car & Foundry Co. General Specifications of Canadian Car-Brill Trolley Coach Model T-44, February 1946) The new model T-44 trolley bus, like the ACF-Brill model TC-44 trolley buses in the SRD fleet, could seat 44 passengers. The appearance and the construction of the model T-44 trolley bus was significantly different.

The underframing of the buses consisted almost entirely of heat-treated aluminum alloy "I" beams and extruded channels instead of steel. The aluminum structural members were either bolted together or were cold riveted together with aluminum alloy rivets. Certain parts of the framing, such as the motor mounting areas and the front corner posts, were fabricated of steel alloy sections which were bolted to the aluminum structural members. Secondary structures, such as electrical cabinets and ductwork, were fabricated of sheel steel and were spot welded together. (Canadian Car & Foundry Co. Specifications, 1946, p. 3)

The external sheathing and the interior ceiling panels consisted of sheet aluminum which was riveted to the framing. The wainscoating consisted of masonite panels. Non-combustible insulation was installed between the exterior and the interior panels. Each bus possessed a single-width front entrance door as well as a treadle operated centre exit door. The side windows, with the exception of the small windows closest to the rear and the front of the bus, were rectangular in shape. These windows were formed with extruded aluminum and consisted of a stationary upper portion about one quarter the height of the window. The lower portion of each openable window was divided into two sections. The section facing the front of the bus could be slid back in order to open the window. This arrangement provided ventilation while making it difficult for passengers to stick their arms out. (Canadian Car & Foundry Specifications, pp. 3-5) It should be noted that the general appearance of these trolley buses was quite similar to the appearance of the C-36 motorbuses except that the T-44 buses possessed a small, vertically positioned fixed elliptical window near the front of each side because of the T-44's increased length over the C-36. (See Plate 37 and Appendix I)

The electrical equipment supplied with these buses was quite similar to the apparatus supplied with the two ACF-Brill trolley buses. The motor and the control equipment was manufactured in Canada by the Canadian General Electric Company (CGE). (Canadian Transportation, December 1946, pp. 688-690) The CGE 1213 motor was an altered version of the General Electric 1213D7 motor. The CGE version was altered in order for it to be easily installed on the Canadian Car and Foundry Brill trolley buses, and in order for the motor to function more efficiently in Canada's colder climate. The CGE version of the motor was described as type 1213PA. (CGE List of Electrical Parts for Canadian-built Brill Trolley Coaches) The compressed air for the brakes and the doors was provided by a single GE type CP-25 compressor which was similar to the air compressors supplied with the two ACF-Brill model TC-44 trolley buses. (Canadian Car & Foundry Co. Specifications, 1946, p. 12)

The interior lighting on these trolley buses consisted of two parallel rows of ceiling-mounted fixtures which were wired in series in order to be able to use the trolley voltage. It was believed that better lighting was achieved by using high voltage circuits since brighter light bulbs could be used. (Canadian Car & Foundry Co. Specifications, p. 4) A low voltage power supply was still required for the horn, defroster fan, headlights, tail lamps, brake lamps, clearance lamps, step lamps and the lamps in the front illuminated roller sign. The low voltage system also powered the interior signal system which employed a single-tone chime rather than a buzzer. A small motor generator and a battery comprised the low voltage system on these trolley buses. The trolley buses were also equipped with directional signals at the front and the rear of each unit. The directional lamps and the flasher operated on the low voltage system. The directional lamps were clustered with the stop and the tail lamps. A special colored glass lens covered each bulb cluster. (Canadian Car & Foundry Co. Specifications, pp. 4-10) It should be noted that the directional lamp arrangement on these trolley buses was identical to that of the C-36 motorbuses. (See Plate 37) The specifications also stipulated that the buses would be painted and numbered before being shipped. (Canadian Car & Foundry Co. Specifications, p. 12)

Although the original order for 22 trolley buses had not yet been started by the time the specifications were issued in February 1946, the City decided to order another 25 similar trolley buses from Canadian Car and Foundry. (Letter to Commissioner R. J. Gibb from Canadian Car & Foundry Co., March 18, 1946)

By late December 1946, the first order of 22 trolley buses was being completed at Canadian Car and Foundry's Fort William (Thunder Bay), Ontario factory and were ready for shipment to Edmonton. The trolley buses were painted in the red and ivory paint scheme that had been also applied to the model C-36 motorbuses. The new ETS decal monograms were also applied to each trolley bus. (See Chapter VI, and Appendix I) The first 22 T-44 trolley buses were numbered 131 through 152 and arrived in Edmonton during January and February 1947. (Letters to Canadian Car & Foundry Co. from D. L. MacDonald, January 29, and February 3, 1947) The second order for 25 trolley buses, numbered 153 through 177, arrived in Edmonton during September 1947. (Telegrams to ETS Superintendent T. Ferrier from Canadian Car & Foundry Co., September 6-24, 1947)

Equipment Modifications, 1945-1949

The British trolley buses, Numbers 101 through 109, had been placed under adverse conditions during the Second World War and, consequently, were in need of rebuilding. A persistent problem with the Leyland trolley buses, Numbers 104 through 109, was that the circuit breakers supplied by the GEC were tripping whenever any large amount of current was drawn by the motor. This particularly annoying characteristic was a problem that the SRD had attempted to resolve during the War without success. By the end of 1945, the SRD had secured replacement breakers from the GEC in England who were able to supply equipment to civilian customers once again. (Letter to Commissioner R. J. Gibb from GEC, November 26, 1945)

The Second World War caused problems for the three AEC-EE trolley buses (101-103) as well. In 1946, the ETS began to overhaul the motors on these trolley buses. Part of the overhaul included the replacement of the motor field coils. During the War, many of the specifications for these buses had been destroyed during enemy bombing raids so English Electric did not possess the correct specifications for the required field coils. The ETS, therefore, inadvertently received field coils which were suitable for the Montreal AEC-EE trolley buses but which were unsuitable for the Edmonton units. This problem was not realized at first, with the result that all three Edmonton AEC-EE buses were out of service by the end of January 1947. (Telegram to AEC of Canada Ltd., from Commissioner R. J. Gibb, January 29, 1947)

After many unsuccessful attempts at installing replacement field coils, it was discovered that the replacement field coils were not designed for the EE type 408 motors on Edmonton's units. (Letter to Gorman's Ltd. from AEC of Canada Ltd., February 3, 1947) Proper field coils were eventually manufactured by EE and were supplied to the ETs by the end of May 1947. (Letter to Montreal Tramways Co. from D. L. MacDonald, June 12, 1947)

The rebuilding of the British trolley buses continued during 1948 when the ETS replaced the low voltage interior lighting with the new high voltage equipment which was similar to the apparatus installed in the new Canadian Car and Foundry T-44 trolley buses. (Letter to Railway & Power Engineering Corp. from D. L. MacDonald, January 14, 1948) In addition, directional signals were also installed on these buses. (Letter to Canadian Car & Foundry Co. from D. L. MacDonald, March 4, 1948) During this rebuilding, the large batteries used for off-wire meaneuvering were removed since very few trolley buses in Edmonton's fleet were equipped with this feature. The batteries were also expensive to maintain, which added to the operational cost of these vehicles. The pedal arrangement on these buses was also reversed at this time so that they conformed to the pedal operation on the other ETS trolley buses, thus reducing the likelihood of operator confusion. (Letter to Montreal Tramways Co. from ETS Assistant Superintendent D. L. MacDonald, January 27, 1949)

Certain parts could not be obtained for these buses. The metal bellows-type oil seal, which was used between the axle housings and the driveshafts, was one such part. In order to keep the vehicles in service, the drive assembly in one of the rear axles in each British trolley bus was removed. The remaining driving axle was fitted with a special flat seal and spring retainer which was designed by ETS personnel. (ETS Drawing of Application of Gits D.P.-3000 Hispeed Seal) The removal of one of the axle drives meant that the British trolley buses could be used only on those trolley bus routes which did not have steep grades. (Letter to Montreal Tramways Co. from ETS Assistant Superintendent D. L. MacDonald, January 27, 1949) The rebuilding of these buses also included: repainting in the ETS colors then in use, the application of the decal monograms, the replacement of the electrical horizontal wipers with air-operated vertical wipers, and the installation of sealed beam headlights. (Photographs by E. M. Smith) Following the rebuilding, these trolley buses were primarily used for peak-hour service. (Letter to Montreal Tramways Co. from ETS Assistant Superintendent D. L. MacDonald, January 27, 1949)

During this period, the Mack and the Pullman trolley buses were also fitted with high voltage interior lighting as well as directional lamps. (Letter to Canadian Car & Foundry Co. from D. L. MacDonald, March 4, 1948) The directional light clusters replaced the older separate tail and stop lamps originally installed on these trolley buses. Each bus was also repainted as it received the new equipment. (Photographs in Provincial Archives of Alberta, and Photographs in City of Edmonton Archives)

New Equipment, 1948-1949

The ETS continued to order Canadian Car-Brill model T-44 trolley buses during this period. One significant factor for this was the imposition of stiff trade barriers between Canada and the United States, which made the prices of American trolley buses considerably higher than Canadian-built units. (Letter to ETS Superintendent T. Ferrier from Pullman-Standard Car Mfg. Co., December 23, 1947) On March 31, 1948, the ETS ordered 10 model T-44 trolley buses from Canadian Car and Foundry for delivery before the end of that year. (Canadian Car & Foundry Co. Contract for Model T-44 Trolley Coaches, March 31, 1948)

The ten trolley buses were to be similar to the previous 47 units. The following items were also to be included: wooden-framed storm sashes for all side windows; ceiling-mounted farebox lamp; an alcohol evaporator for the compressed air system; a sheet metal partition around the operator's position; hand brake splash shield; brake drum dust shields; and additional hand rails and stanchions. (Letter to Canadian Car & Foundry Co. from D. L. MacDonald, April 21, 1948)

The buses were completed and were delivered to Edmonton during November and December. The buses were numbered 178 through 187. (Telegrams to ETS Superintendent T. Ferrier from Canadian Car & Foundry Co., November-December 1948) In addition to the extra equipment described above, the Canadian Car and Foundry made several changes. The older type of sliding window was replaced by a lift type in which the entire lower portion of the sash could be raised. All of the electrical contactors, relays and fuses were located in the compartment along the left-hand side of the trolley bus. In the past, some of the auxiliary contactors, relays and fuses had been located in a separate cabinet which was located at the extreme rear of the trolley bus. (Author's Photographs) It is probable that electrical apparatus was centralized in the single cabinet in order to facilitate repairs as well as maintenance. One change that the Canadian Car and Foundry had introduced on their model C-36 motorbuses (and one which the ETS did not wish to have on its model T-44 trolley buses), was the use of sheathed flexible cables in place of the older type of solid control rods. The ETS had experienced serious freezing problems with the flexible cables on their C-36 buses and did not wish to have the same problems occur on the new T-44 trolley buses. (Letter to ETS Assistant Superintendent D. L. MacDonald from Canadian Car & Foundry Co., July 6, 1948)

Another five T-44 trolley buses were ordered during May 1949. These buses were the same as the buses supplied in the previous order. One particular feature that the ETS did not wish to have on these units was the lift type of windows that had been supplied with trolley buses 178 through 187. The ETS crews had found it difficult to replace the glass in this type of window and had found glass replacement easier with the older design of sash. (Letter to Canadian Car & Foundry Co. from ETS Assistant Superintendent D. L. MacDonald, May 12, 1949) The Canadian Car and Foundry, however, could not obtain the older type of sash so the ETS had to accept the vertical lift sash. (Letter to ETS Assistant Superintendent D. L. MacDonald from Canadian Car & Foundry Co., May 23, 1949)

The five trolley buses, numbered 188 through 192, were delivered to Edmonton during November and December 1949. (Telegrams to ETS Superintendent T. Ferrier from Canadian Car & Foundry Co., November-December 1949; see also Appendix I) These were the last model T-44 trolley buses to be purchased by the ETS. (See Appendix I)

Equipment Disposal, 1950-1954

During this period, the nine British trolley buses were retired from service. All were out of service by the end of 1951 because they were expensive to maintain and were not popular with either the passengers or the operators. (ETS Repair Foreman's Logbook, and ETS Report on 1951 Trolley and Motor Coach Requirements, March 1951, p. 1) All of the retired vehicles were stored outside the Cromdale car barns until early 1954 when they were sold as scrap. (Photographs in Corness Collection) In 12 years of service, the British buses had become "orphans" and were disposed of because of the high cost of replacement parts and because the vehicle design had rapidly become obsolete; points that had been mentioned in the Wilson and Bunnell Report of 1938.

New Equipment, 1952-1954

During 1951, the ETS had terminated streetcar service and had found itself short of rolling stock even though every effort had been made to obtain additional motorbuses. (See Chapter VI, and Letter to Commissioner D. Menzies from Twin Coach of Canada, April 11, 1951) Although Canadian and American involvement in the Korean War had adversely affected the production of motorbuses, trolley buses were still readily available. In view of this situation, the ETS ordered four large model trolley buses from the Canadian Car and Foundry during December 1951. (Letter to the City Commissioners from ETS Superintendent D. L. MacDonald, March 3, 1952)

These trolley buses, which were designated model T-48A, were larger than the T-44 model and could seat 48 passengers. The T-48A model trolley bus was similar in appearance to the model T-44 but the T-48A did not possess the small eliptical window near the front of the bus on the left-hand side. In addition, the T-48A trolley bus had a longer front overhang which enabled these buses to be equipped with double-width front doors. (Canadian Car & Foundry Co. Specifications of Canadian Car Brill Model T-48A Trolley Coach, April 1950)

The construction of the T-48A trolley bus was somewhat different from the construction of a T-44. The underframing of the T-48A bus consisted primarily of steel members rather than aluminum alloy. (Canadian Car & Foundry Specifications, April 1950) The use of steel members in the longer trolley bus reduced the likelihood of premature frame fatigue. The electrical apparatus for the T-48A trolley bus was identical to the apparatus supplied with the model T-44 trolley bus. (Canadian Car & Foundry Co. Specifications, April 1950)

The four model T-48A trolley buses were painted in the standard ETS colors and were numbered 193 through 197. They were delivered to Edmonton during March 1952. (ETS Listing of Buses, 1955; see also Appendix I) Plate 44 (Author's Photograph) shows the appearance of T-48A trolley bus Number 195 in early 1977. The wooden storm sashes should be noted. The ETS cast aluminum crest visible in this plate was applied to this bus sometime during the 1960's.

An additional six model T-48A trolley buses were ordered during August 1954 and were delivered to Edmonton by the end of that year. (CECR No. 24, August 9, 1954) These buses were similar to the previous order of T-48A trolley buses received by the ETS. The seating arrangement on the six new trolley buses was altered so that single cross seating was installed along the left-hand side of each bus in order to provide more room for standees. This seating arrangement reduced the total seating capacity on these trolley buses to 42. (Author's Photographs) The six new T-48A trolley buses were numbered 197 through 202 and were the last new trolley buses purchased by the ETS until 1973. (See Appendix I)

Equipment Modifications, 1954

It was mentioned in the previous Chapter that the ETS introduced the use of fibreglass replacement panels on their buses during 1954. The use of such panels was also extended to the trolley bus fleet. (Edmonton Journal, October 18, 1954, p. 21) The use of fibreglass panels was facilitated on the model T-44 and T-48A trolley buses since their body panels were the same, in most instances, as the body panels on

Plate 44. (Author's Photograph) Trolley Bus Number 195

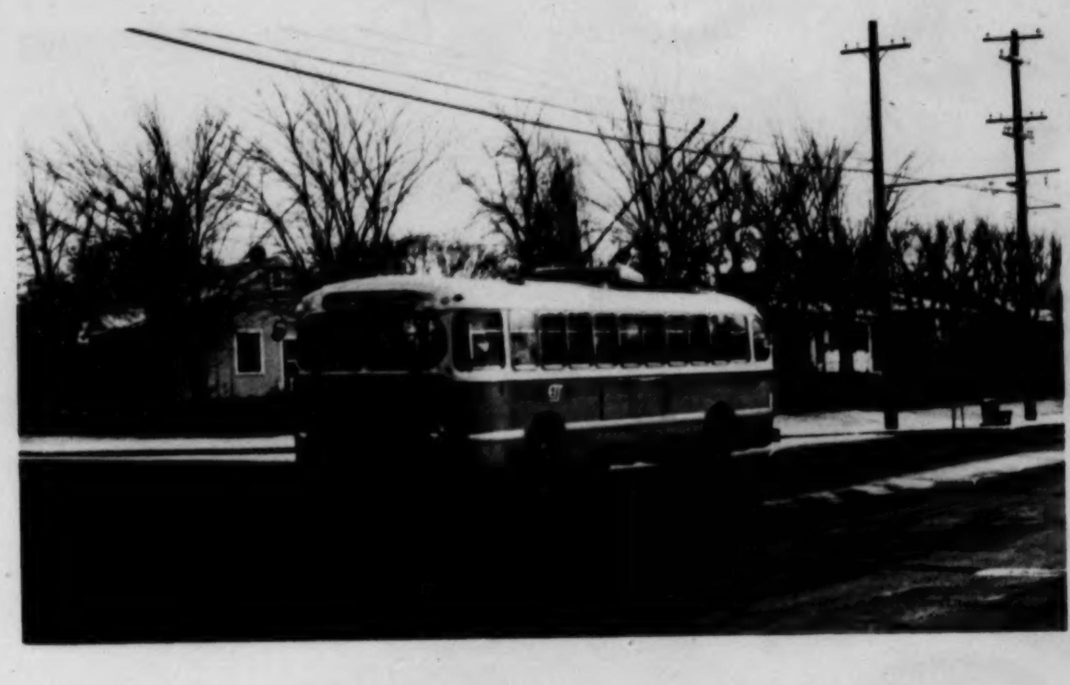
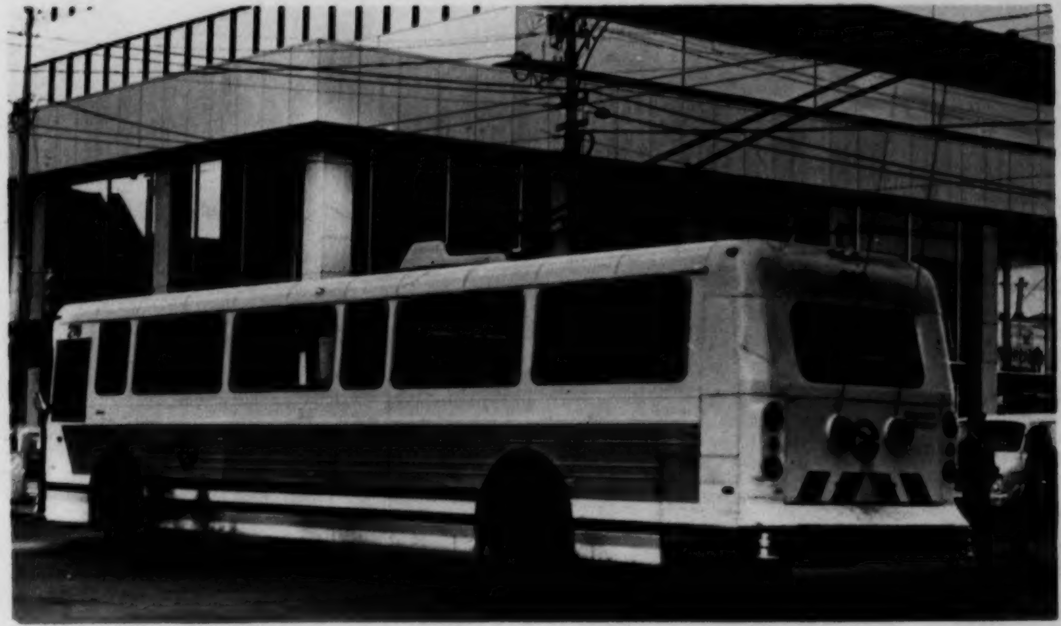


Plate 45. (Author's Photograph) Trolley Bus Number 216, Modified Rear Section



the C-36 motorbuses. (See Plates 37 and 44)

Equipment Modifications, 1959-1965

The operation of the air suspension system installed on new GMC motorbuses beginning in the 1950's was described in Chapter VI. The chapter also mentioned that the Twin Coach Company of Canada had developed an air suspension conversion kit for several types of ETS buses that were equipped with leaf springs. The kits had been developed in an attempt to reduce spring maintenance on the buses equipped with leaf springs. (See Chapter VI)

The trolley buses suffered from frequent spring breakages in addition to the motorbuses; in early 1960, the ETS began to install air suspension conversion kits on the Canadian Car and Foundry trolley buses in their fleet. In the previous year, the ETS had attempted to install a conversion kit on one of the Pullman-Standard trolley buses, Number 115. The conversion did not work well with this trolley bus because it possessed very long leaf springs. (Letter to Twin Coach of Canada from ETS Assistant Superintendent of Maintenance B. H. Booth, March 9, 1960) It was eventually decided by the ETS not to install air suspension on the Pullman-Standard trolley buses because they were due for retirement by the end of 1965. The conversion of the Canadian Car and Foundry trolley buses continued and by the end of 1964, all but six of that make had air suspension installed. (Letter to the City Commissioners from ETS Superintendent D. L. MacDonald, December 3, 1964) The remaining Canadian Car and Foundry trolley buses had the air suspension kits installed during 1965. (ETS Repair Foreman's Logbook)

During this period, several Pullman-Standard trolley buses had their roof mounted air intake scoops replaced by side-mounted louvered air intakes. (Author's Photographs) The new air intake arrangement reduced the amount of moisture that entered the air cooling system. All Pullman-Standard trolley buses did not receive this modification since some units were in poor condition and were due for imminent retirement.

Used Equipment, 1962

By the early 1960's, some of the older trolley buses, such as the Macks and some of the Pullman-Standard units, were beginning to require extensive overhauls if they were to remain in serviceable condition. At the same time, the British Columbia Electric Company of Vancouver was attempting to dispose of its model T-44 trolley buses because they wished to standardize their trolley bus fleet to one particular model, the T-48A. The ETS, therefore, was able to obtain ten Vancouver T-44 trolley buses for less expense than it would have cost the ETS to overhaul its older trolley buses. The purchase of the ten used trolley buses was approved and the units arrived in Edmonton by rail during November. (Memorandum to the City Commissioners from ETS Superintendent D. L. MacDonald, October 31, 1962) It should be noted that no new trolley buses were being manufactured in North America at this time. (Edmonton Journal, January 25, 1960, p. 22)

The ten Vancouver T-44 trolley buses had been manufactured during 1947 and were quite similar to ETS trolley buses Numbers 131 through 177. The Vancouver units, however, contained a gate which was used to open the centre exit door. In addition, these trolley buses possessed a modified wiring system in the interior lighting so that the four lights nearest the front of the interior were somewhat dimmer than the other lamps in the interior. This feature was intended to improve the operator's night visibility. (Author's Photographs)

The ten Vancouver trolley buses were repainted in the ETS colors and received the new ETS cast aluminum crest which was described in Chapter VI. The trolley buses were numbered 203 through 212. (Author's Photographs; see also Appendix I)

Equipment Disposal, 1960-1965

The arrival of the ten Vancouver trolley buses enabled the ETS to retire some of its older trolley buses. The three Mack units, Numbers 110 through 112, in addition to several Pullman-Standard trolley buses were retired and sold for scrap. (Inventory of ETS buses, November 1966; see also Appendix I)

Used Equipment, 1966

In early 1966, the Regina (Saskatchewan) Transit System terminated its trolley bus service. The ETS was able to purchase ten model T-44 trolley buses from Regina. The buses were delivered to Edmonton by rail during March. (Letter to the City Commissioners from ETS Superintendent D. L. MacDonald, March 20, 1966, and Photographs by C. K. Hatcher) These trolley buses had been manufactured during 1949 and were similar to ETS units 188 through 192. The trolley buses were placed in service immediately and were gradually repainted and renumbered. The ten Regina T-44 trolley buses were numbered 121 through 130 by the ETS. (ETS Listing of Buses, 1966) It should be noted that these numbers had been used previously for some of the Pullman-Standard trolley buses as well as for the ACF-Brill trolley buses.

Equipment Modifications, 1962-1967

During this period, the Canadian Car and Foundry trolley buses were repainted and were decorated with the new aluminum ETS crest instead of the fragile decal monogram. (Author's Photographs; see also Chapter VI)

Equipment Disposal, 1966

The arrival of the ten Regina trolley buses enabled the ETS to retire the remaining Pullman-Standard trolley buses as well as the two ACF-Brill units. (Inventory of ETS Buses, November 1966) One Pullman-Standard trolley bus was preserved by the ETS. This came about not because of the ETS but because of the request of a private citizen. (CECR No. 47-2, August 24, 1965) The unit selected was Number 116. For some obscure reason, the ETS decided to renumber the unit 113, which had been the number of the first Pullman-Standard trolley bus. (Author's Photographs; see also Appendix I)

Equipment Modifications, 1967-1970

The clustered tail light housings on the Canadian Car and Foundry buses were frequently difficult to see. In addition, it was becoming difficult to obtain parts for them. The former Vancouver trolley buses also possessed additional tail light housings which were not a standard feature in the ETS fleet. On some of the Canadian Car and Foundry buses, the ETS installed three separate lamp housings for each single tail light housing. The lamp housings were arranged vertically and were mounted flush with the back of the bus. The directional lamp was the uppermost. The stop light was in the centre and the tail light was placed at the bottom. Each lamp was enclosed by a 4½ inch (11.4 mm) diameter red lens. (ETS Drawing of Tail Lamp Conversion, 1967) Although the new tail light arrangement resulted in improved visibility, several trolley buses did not receive the new tail light configuration. (Author's Photographs)

Used Equipment, 1969

During 1969, the City of Winnipeg was in the midst of closing its trolley bus system. The ETS was able to purchase 15 model T-44 trolley buses from Winnipeg for parts only. (ETS Interdepartmental Memorandum from S. R. Daviss, December 1969; see also Appendix I) The ETS received the buses complete and removed items such as: main motors, air compressors, trolley poles, trolley bases, differentials, rheostats, blower motors, windshields, miscellaneous windows and doors. Following the removal of all useful parts, the buses were sold as scrap. (ETS Listing of Disposals, July 6, 1972, and Author's Photographs) The salvaged parts were used to maintain the existing ETS trolley bus fleet. (Memorandum to ETS General Manager D. L. MacDonald from Director of Equipment S. R. Daviss, August 3, 1971)

New Equipment, 1973-1976

Without the acquisition of new trolley buses, the ETS could not hope to keep the trolley bus system functioning. Many of the T-44 trolley buses were over 25 years old and some were developing structural cracks. During 1970, however, the TTC embarked upon a trolley bus rebuilding program. The TTC possessed a large number of trolley buses that were in dire need of replacement. Instead of abandoning the pollution-free trolley buses for diesel buses, the TTC purchased new bodies, had the electrical apparatus stripped from the old units and rebuilt, and installed the rebuilt electrical apparatus in the new bodies. The new trolley bus bodies were supplied by the Western Flyer Company of Winnipeg, Manitoba and were an unpowered version of the model D700 motorbus. (Canadian Coach, June 1971, pp. 3-5; see Chapter VI for description of the Western Flyer model D700A motorbus) The TTC installed the rebuilt electrical equipment on each unit. When complete, the TTC had a new trolley bus although with rebuilt electrical apparatus that was technologically obsolete. (Canadian Coach, June 1971, pp. 3-5)

Other cities became interested in the procedure started by the TTC and in early 1972, TTC trolley bus Number 9213 was sent to Edmonton for demonstration purposes. (Canadian Coach, February 1972, p. 7, and Photograph by J. A. Kernahan) The ETS was impressed with the appearance and the performance of the new trolley bus and in early 1973, the City Council approved the order of 37 trolley buses of this kind. (Canadian Coach, May-June 1973, p. 17) By this time, the Western Flyer Company had become Flyer Industries Limited and the new 800 series buses were being manufactured. (See Chapter VI) The trolley buses ordered by Edmonton were designated as model E10240 and were similar in construction and identical in appearance to the model D10240 motorbuses that were described in Chapter VI. The model E10240 bus did contain some differences in construction. A new double-reduction rear axle was provided with each bus. In addition, the rear compartment and the underframing of the bus was designed to support a CGE 1213 motor in addition to the required control apparatus. The rheostats were to be placed in a cabinet which was located near the centre of the bus. This cabinet also contained new auxiliary heaters. The cabinet was connected to the wall type of heating distribution ducts that were also found on the model D10240 buses. A separate electric fan operated from trolley voltage provided the air flow for the interior heating of the trolley bus. An electric defroster and fan assembly were also installed in front of each trolley bus. The design of the heating system on these units meant that storm sashes were not required. Each trolley bus could seat 44 passengers. Each bus was also equipped with insulated trolley boards and a section of rubber matting placed on the roof behind the trolley boards provided additional insulation for any individuals working on the roof. The cowling for the trolley bases was also supplied and it consisted of fibreglass. (Flyer Industries Specifications of Series 800 Trolley Coach, 1973) A re-location of Flyer's factory delayed the production of these units. The first trolley bus was delivered incomplete to the ETS during October 1974. The final fitting of the remanufactured electrical apparatus was undertaken at the ETS facilities. (Edmonton Transit News, November 1974, p. 1)

The unit was powered by a factory reconditioned CGE 1213 motor in addition to a reconditioned and modified cam controller. New contactors and relays were provided. The motor and the controller were obtained from one of the former Winnipeg trolley buses purchased during 1969. (Memorandum to ETS General Manager D. L. MacDonald from Director of Equipment S. R. Daviss, August 3, 1971) One significant change to the control system was the elimination of the power control rod.

A common complaint associated with the Pullman-Standard trolley buses (which also had the controller located at the rear of the bus) was that pedal operation was quite stiff because of the extreme length of the control rods. A system of air operation for the controllers was devised and installed on the new Flyer trolley buses. The power pedal was connected to a return spring as well as to an air controlling valve. The air valve controlled the amount of air pressure admitted to a pipe which led to a small air cylinder connected to the controller's main camshaft lever. The action of the power pedal would, therefore, be transferred to the controller without much foot pressure. In normal operation when the power pedal was depressed, the air valve allowed a certain amount of compressed air to reach the controller cylinder. The piston in the cylinder would be moved and, in turn, would move the lever attached to the controller's main camshaft. When the operator removed foot pressure from the pedal, the air valve would allow the compressed air to escape. A return spring inside the air cylinder forced the piston back to its original position which, in turn, would move the controller back to the "off" position. The remanufactured control equipment provided for dynamic braking but did not permit regenerative braking. The compressed air for the bus was supplied by a reconditioned GE Air compressor. (Author's Observations)

Tests with the first unit revealed some serious problems with the remanufactured electrical apparatus. In the past on streets where a double set of trolley wires existed, an operator could transfer the trolley poles onto the set of wires above the opposite side of the street in order to be able to maneuver the trolley bus around a large accident or some other temporary obstruction. When this operation was attempted with the new Flyer trolley bus, various relays and contactors overheated to the point where they began to burn. It had become apparent that some of the new components had not been designed to ignore changes in polarity. (ETS Interdepartmental Memorandum from Director of Equipment S. R. Daviss, November 25, 1974)

The electrical problems were eventually corrected and the bus was numbered 213 and was placed in service. (Author's Photographs)

The remaining 36 trolley buses were outfitted with the electrical and the air apparatus at the Flyer factory. The motors and air compressors for these units came from various Canadian Car and Foundry trolley buses retired from the ETS fleet as well as from 20 Calgary trolley buses which the ETS purchased for parts during 1974. (Letter to Calgary Transit System Superintendent of Maintenance D. Miller from ETS Director of Equipment S. R. Daviss, July 26, 1974; see also Appendix I)

Serious labor difficulties within Flyer Industries delayed the completion and the delivery of the remaining trolley buses. (Edmonton Journal, August 1, 1975, p. 7) Twenty-three units were delivered to the ETS during 1975. They were Numbers 214 through 234 and Numbers 236 and 237. The remaining 13 units were delivered during 1976. (ET Listing of Buses, 1976) Plate 40 (Author's Photograph) shows the appearance of trolley bus Number 247 during 1978. It should be noted that the ET insignia and the word "Transit" on the left-hand side of the bus were added during 1976 after the bus had arrived in Edmonton.

Equipment Disposal, 1973-1976

The ordering of 37 trolley buses in 1973 enabled the ETS to retire some of their Canadian Car and Foundry trolley buses that were in very poor condition. As each bus was retired, the electrical propulsion equipment as well as the air compressor were removed for reconditioning and installation on the new Flyer Industries units. (Memoranda from L. F. Wiebe to S. R. Daviss, October 1973-January 1975)

Used Equipment, 1974

During 1974, the Calgary Transit System terminated its trolley bus operations and was disposing of its old equipment. The ETS was able to purchase 20 Calgary trolley buses for the electrical components since the apparatus was required for the new Flyer trolley buses being assembled for the ETS. The buses were purchased complete. When the required parts were stripped, the bodies were sold as scrap. (Letter to Calgary Transit System Superintendent of Maintenance D. Miller from ETS Director of Equipment S. R. Daviss, July 26, 1974, and Author's Photographs) The units purchased from Calgary included several model T-44 buses as well as some model T-48A trolley buses. (See Appendix I)

Equipment Modifications, 1976-1980

It was mentioned in Chapter VI that in early 1976, the Edmonton Transit System adopted a new paint scheme and insignia and dropped the word "System" from its name. The Flyer trolley buses which had been ordered in 1973 arrived in the old ETS colors and were not immediately repainted in the new ET colors. The new ET insignia as well as the new number placement were applied to these buses. (Author's Photographs) The remaining Canadian Car and Foundry trolley buses, which were gradually being retired, had their numbers reapplied above: the front door, the operator's window, and above the rear window in order for these buses to conform to the new numbering placement. In addition, the old ETS crests were removed and were replaced by strips of adhesive paper with the new ET insignia and the word "Transit". (Author's Photographs) Beginning in 1977, ET began the gradual repainting of the Flyer Industries trolley buses beginning with Number 232. (Author's Photographs) During this period, ET installed two small electric fans on the dash of each Flyer trolley bus since the air flow from the defrosters was usually insufficient in keeping condensation from forming on the lower portions of the windshield inside the bus. (Author's Observations) Edmonton Transit also began to install the new type of roller signs in which the destination portion of the front roller sign was moved by means of a small electric motor. (Author's Photographs)

One particularly unpopular feature of the Flyer Industries trolley buses was the triangular housing located on the roof of the bus at the rear. This housing, which was designed to enclose optional air conditioning equipment, tended to protrude enough so that the trolley ropes rubbed or snagged against the housing, causing the trolley ropes to fray or the trolley poles to dewire. This housing, which was also found on the diesel model 10240 buses, also interfered with washing operations. In order to alleviate these problems, Flyer Industries fabricated formed metal transition pieces which were designed to replace the superfluous air conditioner housing. (Transit Canada, November-December 1977, p. 12) The new transition pieces were gradually installed on each Flyer trolley bus, usually as each unit underwent repainting. (Author's Photographs) Plate 45 (Author's Photograph) depicts the rear view of trolley bus Number 216 in the ET paint scheme with the new transition piece in place of the triangular air conditioning housing. The clearance between the bus and the trolley ropes should be noted.

Beginning in 1978, ET began to install two-way radios in all of their rolling stock. (ETAR, 1979, p. 15) While permanent radio sets were installed in the Flyer trolley buses, hand-held portable units were used for the remaining Canadian Car and Foundry trolley buses. (Author's Observations)

Another modification introduced during this period was the installation of gates to open the centre exit doors on the Flyer trolley buses in lieu of the rubber treadle mats. (ETAR, 1979, p. 15) It should be recalled from Chapter VI that the gates were installed because cold weather frequently caused the rubber treadle mats to stick. The centre exit doors, therefore, would either remain open or would not open.

The large height of the side windows on the Flyer trolley buses meant that the signal cords, which were located above the tops of the windows, were beyond the reach of short passengers. In order to enable short passengers to pull the cords, ET installed small lengths of cord on the window frames and on the posts between the windows. These lengths of cord were attached to the signal cords by means of loops and were allowed to drop vertically to a point just above the wainscoating. The lower ends of the cords were looped through small guide rings which were secured to the paneling. The action of pulling on any of the vertical cords caused one of the horizontal signal cords to be pulled as well, and this rang the signal chime. This modification enabled the shortest passenger to operate the signal chime. (Author's Photographs and Observations)

Equipment Disposal, 1977-1980

Following the arrival of the 37 Flyer Industries trolley buses, ET began to remove the remaining Canadian Car and Foundry trolley buses from service. While several units were removed from service during 1977, they were not scrapped immediately because ET believed that they would be required during the Commonwealth Games which were to be held in Edmonton during the summer of 1978. All Canadian Car and Foundry trolley buses were removed from service by November 1978, with the last run being a special charter on November 19. (Author's Photographs) Following their removal from service, ET preserved two model T-44 buses, Numbers 148 and 191, as well as a single T-48A trolley bus, Number 202. (See Appendix I) At this point, ET possessed a trolley bus fleet of only 37 units, the lowest number of such vehicles since 1946. (See Appendix I)

Thirty-seven of the retired Canadian Car and Foundry trolley buses retired during November 1978 were stored outside ET's Westwood garage in operating condition. Edmonton Transit hoped to be able to sell the 37 units to some other city that still operated trolley buses. No such buyers were forthcoming so the City of Edmonton offered them for sale as a lot locally in January 1980. (City of Edmonton Notice of Tender, January 10, 1980) The buses were subsequently sold and were removed from the premises. (Author's Photographs)

New Equipment, 1980-1982

As the Canadian Car and Foundry trolley buses were being retired, the question of retaining trolley bus service arose. Many other Canadian, American and European cities were replacing their trolley bus systems with diesel buses. In view of this development, the City of Edmonton hired a local consulting firm in 1975, Hu Harries and Associates, to undertake an analysis of the future requirements for transit vehicles in Edmonton. The report ascertained that the ideal life of a motorbus was 15 years, while that of a trolley bus was over 25 years. The report concluded that while trolley buses were more expensive to purchase than diesel buses, trolley buses: reduced harmful air pollution, were quieter in operation than diesel buses, lasted longer in operation than motorbuses, and required less maintenance than most motorbuses. An updated version of the report in 1977 recommended the acquisition of a sufficient number of trolley buses in order that there be at least 105 units available for daily service. (Aldermanic Seminar Report, 1978, pp. 3-5)

After considering these reports, the City Council approved the purchase of 100 new trolley buses on July 10, 1979. (Edmonton Journal, July 11, 1979, p. A2) Bids for the trolley buses were solicited from both North American and off-shore manufacturers. The deadline for the submission of bids was April 1980. The bidding companies included: Elroy Engineering of Australia which could provide either traditional cam control or electronic control; Flyer Industries who could supply rebuilt cam control, or new apparatus supplied by the Japanese Toshiba Company; Brown Boveri Company which would install their electronic apparatus in a GMC model 5307 bus body; Bombardier Industries of Montreal which could supply trolley buses with either cam or electronic control; and the Mack Truck Company in conjunction with the French Renault Company which could supply trolley buses equipped with either cam or electronic control. (Accepted Tenders for Trolley Buses, 1980)

On August 13, the City Council selected the bid of the Brown Boveri Company. (Canadian Brown Boveri Co. Contract for 100 Trolley Buses, August 13, 1980) Although Brown Boveri did not submit the lowest bid in price, their equipment had a well-known favorable reputation. In addition, the GMC 5307 bus was well known to ET personnel since Edmonton operated nearly 400 model T6H-5307 GMC diesel buses. (See Appendix I)

The bodies for these trolley buses were manufactured at GMC's Quebec plant and were similar to the T6H-5307 diesel buses described in Chapter VI. Standee windows as well as operator controlled centre exit doors were provided, however. (See Plate 46) The arrangement of the seating on these trolley buses was similar to the seating arrangement on the last six T-48A trolley buses purchased by the ETS, Numbers 197 through 202. The new trolley buses, therefore, could seat only 42 passengers. It should be noted that since GMC was a subcontractor to Brown Boveri, the normal GMC insignia on the front of the bus was replaced with an insignia which contained the letters "BBC" which was short for

Brown Boveri Company. (Brown Boveri Specifications of Chopper Trolley Bus, 1982) The main motor as well as the control apparatus was supplied by the Swiss Brown Boveri Company. It should be recalled from Chapter IV that the first mercury arc rectifier purchased for the street railway in 1929 was also manufactured by Brown Boveri. It had remained in service until the late 1970's.

A single compound wound motor was mounted longitudinally at the rear of the bus and was controlled by a solid state control unit which was called a "chopper". The motor was more powerful than the older GE 1213 motors that had been supplied with most Edmonton trolley buses in the past. The Brown Boveri trolley bus motor could produce a maximum continuous output of 184 H.P. (137.3 kW). The chopper control is a device that uses a patented arrangement of certain discrete solid state components to control the amount of voltage entering the motor's circuits. The chopper is able to accomplish this without dissipating surplus voltage as heat. The discrete components usually include thyristors, diodes and inductors. (Brown Boveri Specifications, 1982) Thyristors have the property of being able to control the flow of electrons through a circuit in much the same way as a mechanical switch but without any moving parts. The amount of voltage in a circuit containing a thyristor can be controlled by repeatedly turning the thyristor "on" and "off" at a rapid rate by means of a triggering signal applied to its gate. In this manner, the trolley voltage is "chopped" or reduced to low values. The chopper control circuits were located in a steel case which was mounted in the rear compartment of the trolley bus. The operation of the chopper produced some heat. Heat can destroy many solid state components so the case was ventilated by air which was forced through the case by an electrically powered blower. The nature of solid state devices is such that minimal and infrequent maintenance is required. It should be remembered that solid state components contain no moving parts.

The power pedal was connected to a small variable resistor which controlled voltage in a circuit which was connected to the chopper's control circuits. Dynamic braking blended with air braking was provided with these trolley buses. The required rheostats as well as auxiliary heaters were located in the heating compartment on the bus which normally contained the hot water heaters on the diesel version of the model 5307 bus. (Brown Boveri Specifications, 1982) Trolley voltage was obtained from two roof mounted Ohio Brass trolley bases which were enclosed by a fibreglass cowling. (See Plate 46)

Power for the low voltage lighting was provided by a solid state converter which changed trolley voltage to 12 volts D.C. without the use of any mechanical devices such as motor generators. The converter also charged a small 12 volt battery which kept the lights on in the event of a power loss. The air compressor supplied with these trolley buses was an Atlas-Copco Company model LE 6 unit which was directly coupled to an electric motor. Instead of a reciprocating piston type of compressor, the Atlas-Copco compressor employed a rotating shaft which held several vanes to compress the air. This type of air compressor, in addition to having a higher output than the older type of reciprocating piston compressor, had fewer moving parts which meant that there were fewer parts to service or replace. The electrical apparatus also included an insulation test panel which enabled maintenance crews to test the effectiveness of the various electrical insulators on the trolley bus. This arrangement was similar to the test plug apparatus supplied with the AEC-EE trolley buses of 1939. It should be noted that Brown Boveri had the apparatus to provide either battery maneuvering or maneuvering by means of a small generator powered by a gasoline engine. Neither of these options were selected by ET. (Brown Boveri Specifications, 1982)

The use of solid state apparatus as well as an air compressor of modern design helped to make these trolley buses extremely efficient and relatively maintenance free.

The final assembly of the trolley buses was done in Edmonton by the contracting firm of Bennett and Emmott. The bus bodies arrived in Edmonton painted white with ET numbering but were not supplied with the ET insignia or the yellow and blue stripes. (Author's Photographs) As each bus was completed in Edmonton, it was tested on the trolley lines and when any problems were corrected, the buses were delivered to ET who applied the remaining portions of the paint scheme. (Author's Photographs)

The 100 Brown Boveri trolley buses were numbered 100 through 199. (See Appendix I) Number 100 arrived in Edmonton during October 1981 and was placed in service during November. The remaining units were placed in service during 1982. (ETAR, 1982, p. 30) Plate 46 (Author's Photograph) shows trolley bus Number 100 in early 1982. The standee windows as well as the steps to the roof should be noted.

The acquisition of the 100 new trolley buses provided ET with the largest number of trolley buses in its history. The new trolley buses were far more efficient than any of the earlier trolley buses. In addition, the use of solid state components instead of mechanical devices such as cam controllers, greatly reduced the amount of maintenance required for these trolley buses. In addition, the use of the GMC 5307 bodies for the new trolley buses meant that many of the parts stocked for body repairs for the GMC diesel buses could also be used for the Brown Boveri

Plate 46. (Author's Photograph) Trolley Bus Number 100

Plate 47. (Author's Photograph) Cut and Cover Construction at North End of Churchill Station, 1977

units. A separate inventory of parts was not required, therefore.

It should be recalled from Chapter IV that the electric power and distribution system for the trolley buses had undergone extensive modernization during the late 1970's and in the early 1980's which helped to increase the efficiency of trolley bus operation. Although the trolley bus has not yet regained its previous status as the mainstay of the transit fleet, the proven longevity of the trolley bus combined with: high energy efficiency compared with motorbuses; infrequent maintenance; no air pollution; quiet operation and fast acceleration have made the trolley bus an inexpensive transit vehicle of the present and the future. The technological development of the trolley bus has made that type of vehicle more efficient and cost effective than the common diesel bus which proves that this system of transportation technology is far from being obsolete. With the decreasing supply of fossil fuels, combined with their rising cost, it would be very foolish to entertain the notion of replacing trolley buses with diesel buses with the idea of decreasing costs.

Chapter VIII

Light Rail Transit Construction

Introduction

The idea of using a rapid transit system in Edmonton that employed high-capacity vehicles travelling on a separate grade from street traffic was first mentioned by ETS Superintendent D. L. MacDonald in early 1960. MacDonald stated,

> It is inconceivable that the city should reinvest in vehicles geared only to surface traffic conditions for the central area of the city far into the future . . . a new system must be developed for the transportation of people within approximately a four-mile [6.4 km] core of the central area of Edmonton, involving people travelling at different levels for safe efficient movement. (Canadian Transportation, February 1960, p. 34)

In spite of numerous studies, reports and increases in transit ridership and City population, no rapid transit system was planned for construction until early 1974 when the Provincial government indicated that it would provide substantial financial aid for public transit improvement. (Edmonton Journal, February 4, 1975, p. 42)

The projected rapid transit line was intended to travel from the central core of Edmonton to the northeast, where new residential development was anticipated. The total length of the initial line was to be approximately 4½ miles (7.2 km), with 1 mile (1.6 km) to be underground near the centre of the City. (ETS Specifications of Northeast Rapid Transit Line, 1974) The rolling stock to be used on this rapid transit line was to consist of light-weight electrically powered vehicles that would travel along steel rails in much the same manner as the obsolete streetcars had done. The grade of the rapid transit line was to be isolated from the streets, however. (Letter to City of Edmonton Finance

Department from Waggonfabrik Uerdingen A. G. [Duewag], October 8, 1974) In most other rapid transit systems in North America, extremely heavy vehicles travelled along the rails. Such vehicles were usually noisy and had to be isolated from inhabited areas because of it. Edmonton's rapid transit system, which was to use light-weight vehicles, was designed to travel on the surface of the ground through inhabited areas in addition to travelling underground. This system of using light-weight vehicles on rails was called "Light Rail Transit", or LRT. (ET Brochure on Edmonton's LRT System, 1978)

It should be understood that while the type of vehicle selected was not widely used in North America, light rail vehicles were in wide use in many European cities on rapid transit systems as well as on street railways. In addition, the basic construction methods of Edmonton's LRT system were modified versions of underground and street railway construction methods first developed during the nineteenth century. (See below)

Underground Construction, 1974-1978

The original underground portion of the LRT system was to travel from the area of 101st Street and Jasper Avenue to a point immediately west of 95th Street north of 105th Avenue. (ETS Specifications of North-east Rapid Transit Line, 1974) Construction began during September 1974 with the excavation of the tunnel entrance near 95th Street. (Author's Photographs, and Edmonton Journal, October 15, 1974, p. 1)

Two basic construction methods were used for the underground portions of the line; cut and cover, and bored circular tunnel. Both construction methods had their origin in nineteenth century London, England. The cut and cover method entailed the removal of earth to a certain depth in order to create a large trench. The trench was then lined with bricks, concrete or some other building material, and was then covered with a building material that could withstand the weight of street traffic or buildings. The railway tracks were placed in the trench and the movement of passengers was not impeded by street traffic. The first use of the cut and cover method by an urban underground railway was in 1860 with the construction of London's Metropolitan Railway. (Lee, 1975, pp. 7-11) There were two major disadvantages to the cut and cover method. Firstly, it was necessary to remove everything overlying the area of the trench so the method was impractical for use in areas where there were large existing structures. In order to avoid the removal of existing structures, the second disadvantage was encountered. Most underground railways of that era travelled beneath existing roads since there were no structures to remove above the roads. While the construction of the trench took place, however, vehicular traffic along the roads was disrupted which caused extreme inconvenience. (Miller, 1940, pp. 82-98) In addition, such underground railways were frequently longer than necessary because they followed the lay of the streets instead of travelling in a straight line from one point to another beneath structures. In view of these disadvantages, an engineer named James H. Greathead designed a system of underground excavation which did not disturb the overlying earth or structures. Using a patented circular excavating shield and cast iron retaining segments, Greathead constructed the first circular, or tubular, railway tunnel in London. The tunnel was completed in 1870. (Lee, 1974, p. 10)

Although the tubular boring method enabled underground railways to travel beneath buildings, it was more expensive to construct and it did not facilitate the construction of stations which were usually located near the surface. (Miller, 1940, pp. 86-90) Edmonton wished to have spacious two-level underground stations with the trains travelling through the lower level; and shops and passageways to buildings on the upper level which was to be located immediately below street level. (ETS Specifications of Northeast Rapid Transit Line, 1974) In order to construct a station in this manner, a version of the cut and cover method was selected. The stations, therefore, are located beneath streets rather than beneath structures.

Two underground stations were constructed in this manner: Central Station, which is located beneath Jasper Avenue between a point west of 101st Street and a point east of 100A Street; and Churchill Station, which is located beneath 99th Street between 102nd and 103rd Avenues. (Author's Photographs) In both cases, construction was designed to keep the disruption of street traffic to a minimum. In order to accomplish this, it was decided to remove the road surface only after the side supports for the stations were in place. The sides of the stations were to consist of large concrete support pilings which would support the roof of the stations as well as the upper floor. Drilling for the piles began early in 1975, using large mechanically-driven steel augers which were approximately 42 inches (1 067 mm) in diameter. The holes for the pilings were placed adjacent to each other in long rows. Each row of holes was placed near an edge of the road, with both rows being spaced approximately (18 600 mm) apart. While the usual depth of the holes was 60 feet (18 288 mm), every fifth hole was bored to a depth of between 90 and 99 feet (27 432 - 30 175 mm). In addition, the bottoms of the longer holes were reamed with a special cutting bit which excavated a bell-shaped bottom designed to distribute the weight on the pile over a large area. The shorter piles were designed to support the sides of the trench below the upper floor, while the longer piles were intended to support a large ledger beam which held the covering of the trench.

After the boring of each hole was complete, a hollow steel casing was lowered into the hole by a crane. A pre-fabricated network of steel reinforcing rods was then lowered into the centre of the casing. Concrete was then poured into the casing until the level came to about 24 feet (7 315 mm) below street level in the case of the shorter piles. The longer holes were filled with concrete until its level was about 7 feet (2 134 mm) below street level. Once the concrete had begun to set, the steel casing was withdrawn from the hole. The surrounding earth provided a form for the setting of concrete piles.

Once all the required piles were installed, the street surface above the piles was excavated until the tops of the longer piles was reached. It should be noted that all utility lines travelling beneath the street were relocated before construction work on the stations began. After the installation of wooden forms and steel reinforcing rods, a concrete "L" or ledger beam was poured along the tops of the longer piles on each side of the street. The ledger beam was approximately 1 550 mm wide at its base and was 2 100 mm in height. The ledger beam was intended to support several pre-cast reinforced concrete beams which would form the roof of the station. In addition to the formation of the ledger beams, interlocking sheet steel panels were driven into the ground along the outside edges of the pilings until their bottoms were just below the tops of the shorter piles. The steel panels not only retained the earth when the area between the two rows of piles was excavated, but they also provided an easy barrier to breach for small tunnels leading to adjacent buildings.

Once the ledger beams were set, the earth between them was excavated to a depth of approximately 24 feet (7 315 mm) to the tops of the shorter piles. In order to accomplish this operation, all street traffic was diverted since the entire street surface had to be removed. After the excavation was complete along the entire length of the station, pre-stressed concrete beams were placed across the ledger beams in order to form the roof of the station. The beams were coated with grout, a plastic waterproof layer, and a 50 mm thick layer of styrofoam insulation. The new road surface, which consisted of steel reinforced poured concrete, was then formed on top of the beams. The surface of this concrete was crowned in order to cause water to flow away from the centre of the street towards the side gutters. (Brooker Engineering Specifications of LRT Underground Stations, 1974, Edmonton Journal, June 13, 1975, p. 63, and Author's Photographs)

When the roofs were completed over the stations, construction continued beneath without further disruptions to street traffic. The next step of the construction was to smooth the floor of the excavated trench. Large channels were then cut into the floor in order to form molds for support beams for the upper floor. Once this was done, a thin layer of sand was deposited to smooth out any minor imperfections. A steel reinforced concrete floor was then poured. The floor contained several large openings to enable elevators, stairs and escalators to be installed later. The floor not only completed the bottom of the mezzanine level, it also served to hold the tops of the shorter piles in position for the next step, the excavation of approximately 22 feet (6 706 mm) below the bottom of the upper floor to form the track level. (Brooker Engineering Specifications of LRT Underground Stations, 1974, and Edmonton Journal, June 13, 1975, p. 63)

In order to be able to excavate, the earth (spoil) had to be removed from the area. In the case of Central Station, ramps were constructed on certain side streets to enable large dump trucks and earth moving equipment to enter the station area. A vacant lot adjacent to the end of Churchill Station enabled a ramp to be built without closing any streets. As excavation proceeded, steel beams were placed temporarily between the piles to prevent the possibility of buckling. Once the required depth was reached, a thick steel reinforced concrete slab was poured which formed the track base and which supported the piles. After the completion of the station floor, the ramps were removed and the basic structure of the stations was complete. It should be realized that a short rectangular concrete tunnel was constructed at the northern end of Churchill Station in order to connect that station with the tunnel leading to the surface near 95th Street. (See Plate 47) Plate 47 (Author's Photograph) shows the appearance of the northern end of Churchill Station during April 1977. The following should be noted: piles on either side, ledger beams, roof beams, and the concrete enclosing the track level.

The tunnel leading northeast from Churchill Station was begun during 1974 and was not constructed in the same manner as the two stations. The tunnel was designed to raise the track level to the surface by 95th Street. In addition, this tunnel did not have to pass beneath any large structures so it could be constructed by the cut and cover method. This tunnel consisted of a steel reinforced rectangular concrete enclosure which was installed in an excavated trench. The sides of the trench were supported by temporary steel pilings which were removed when construction of the tunnel was completed. The roof of the tunnel was supported by the sides as well as by a row of square concrete columns which were located along the centre of the tunnel. The tunnel was enlarged near 97th Street in order to accommodate a possible station in the future. The tunnel emerged at the surface immediately west of 95th Street. A temporary concrete block wall placed at the mouth of the tunnel prevented cold air as well as unauthorized personnel from gaining access to the tunnel. (Author's Photographs)

The cut and cover method could not be used to construct the tunnels joining Churchill and Central Stations because the line of the tunnels was to pass beneath several large buildings. The tubular boring method was used, therefore. Considering the size of the LRT vehicles as well as the required thickness of the tunnel lining, it was decided that the excavated diameter of the tunnels was to be 20 feet 9 inches (6 325 mm). A tunnel was to be provided for each direction of travel between the two stations. The mechanical excavator, known as the "mole", was fabricated by the Lovat Tunnel Equipment Company of Toronto, Ontario to the specifications of the Edmonton Water and Sanitation Department. That Department had the contract for constructing the tunnels because of their extensive experience constructing similar tunnels for Edmonton's sewer system. In addition, the excavator would be used later to construct various large sewers in Edmonton. (Mainstream, February 16, 1977, p. 1 & p. 7)

The excavator consisted of a circular steel ring or tunneling shield which enclosed a large six-bladed cutting wheel that was equipped with numerous carbaloid teeth. An array of hydraulic jacks not only braced the tunneling shield against the circumference of the tunnel, it also served to push the cutting wheel forward a maximum of 5 feet 8 inches (1 727 mm) without moving the tunnel shield forward. Holes near the centre of the cutting wheel channeled the excavated material onto a 46 inch 1 168 mm) wide conveyor belt which, in turn, deposited the material into removal vehicles. A laser beam combined with a computer kept the excavator level and proceeding in the correct direction at all times.

As the excavator advanced, the tunnel was lined with spruce board lagging which was held in place by steel ribs. The lagging and the ribs were installed while the excavator's shield was supporting the recently-excavated portions of the tunnel. This lining prevented the tunnel from collapsing or from allowing the surrounding earth to shift. (Mainstream, February 16, 1977, p. 1 & p. 7)

The excavator was lowered to tunnel level by means of a vertical shaft which was located near the southern end of Churchill Station. The excavator then tunnelled to the eastern end of Central Station, where it was lifted up to street level through another vertical shaft. The excavator was then transported by truck back to the shaft near Churchill Station. Once lowered into the shaft again, the excavator was repositioned so that it could bore another tunnel to Central Station paralleling the first tunnel. While the second tunnel was being bored, the first tunnel was being lined with concrete. In this procedure, crews installed two layers of reinforcing steel along the circumference and the length of the tunnel. One layer of reinforcing was arranged longitudinally, while the second layer was arranged around the circumference. When the reinforcing layers were in place, bolted steel forms approximately 40 feet (12 192 mm) in length were installed inside the tunnel. Small holes were drilled from street level through the wooden lining of the tunnel near the centre of each length of steel form. A lane north of Jasper Avenue was the location for most of the holes. Concrete slurry was then pumped into the holes at pressures up to 2,000 pounds per square inch (13 790 kPa). The pressurized concrete filled all the space between the wooden lining and the bolted steel forms. When the spaces were filled and the concrete had hardened, the steel forms were unbolted and were removed from the tunnel. The tunnel now appeared as a concrete lined tube with an internal diameter of 17 feet (5 182 mm). The boring and the lining of both tunnels was completed by mid 1977. (Mainstream, February 16, 1977, p. 7, and Author's Observations) Several small tunnels connecting each main tunnel, as well as stairways leading from these interconnecting tunnels to panels in sidewalks located above, were then installed. The interconnecting tunnels and the stairways provided emergency escape routes in the event of a derailment or other serious mishap. The side of each tubular tunnel adjacent to the interconnecting tunnels was equipped with a longitudinal line of hinged steel step material that could be lowered in the event of a derailment or a stuck train. The step material was placed at the same height as the bottoms of the passenger vehicle doors. This arrangement enabled stranded passengers to walk along the emergency walkway to one of the interconnecting tunnels where small steel steps enabled the passenger to descend from the steel step material to the floor of the tunnel. (Mainstream, August 17, 1977, p. 3)

The completion of the tunnels meant that the interiors of the stations as well as track laying could be completed. All interior surfaces of the station were sandblasted to remove any soil, dust and loose particles of concrete that could cause dust problems when the stations were in use. A raised tile-covered concrete platform was installed at track level between the location of each track. A raised platform was necessary since the passenger LRT vehicles would not be equipped with steps and ET did not wish passengers to have to negotiate steps when boarding or leaving vehicles. Stairways between the track and the mezzanine levels were installed as well as an elevator and two escalators in each station. Large ventilation pipes were then installed as well as electrical conduits for the stations' interior lighting. The ventilation piping, the electrical conduits and the bare station walls and pilings were all covered by prefabricated concrete panels as well as painted corrugated steel panels that were fastened to the pilings. Additional show cases and partitions on the mezzanine level were fabricated using metal studs and painted plasterboard. (Mainstream, August 17, 1977, p. 3, and Photographs in Author's Collection) Dropped ceilings were installed over both the track and the mezzanine levels. The design of the track level was such that no vertical roof supports were placed between the stairways at either end of the platform. (Author's Photographs) This design feature eliminated the possibility of a passenger walking or being pushed into a support pillar. Concrete and steel structures were also erected around each stairway leading from the mezzanine level to the street. Fare collection apparatus was installed on the mezzanine level in front of the stairways and the escalators. Remote controlled television cameras installed on the ceilings at strategic locations on both levels assisted personnel with security surveillance. (Author's Photographs)

The rail selected for the LRT system was a "T-rail" which was similar in cross-section to the ASCE T-rails that were used in the construction of the ERR. (See Chapter III) The rail was much larger, though, weighing 120 pounds per yard (50 kg/m). The rail was manufactured in 39 and 78 foot (11 897 and 23 774 mm) lengths by steel mills in eastern Canada. The rails were sent by rail to the CNR's Transcona Shops in Winnipeg, Manitoba where the lengths were welded together to form 1,400 foot (42 672 mm) lengths. These long lengths of rail, known as "ribbon rail", were transported to Edmonton on special trains. (Mainstream, October 6, 1977, p. 4) Ribbon rail reduced wheel wear because of the lack of rail joints.

Two main methods of track construction were employed in the underground sections of the line. In the tunnel sections, not including the stations, the rails were secured to raised parallel concrete guideways which were laid along the bottoms of the tunnels. In order to fabricate the guideways along the tubular tunnels, a flat concrete floor had to be poured. Steel reinforcing rods protruding from the floor enabled the concrete guideways to be secured to the floors. (Mainstream, August 17, 1977, p. 3; October 6, 1977, p. 4; and Author's Photographs) Threaded steel studs were inserted in parallel rows into each guideway before the concrete set. The studs were positioned on each guideway so that the correct track gauge; 4 feet 8½ inches (1 435 mm), would be present when the rails were laid. These studs were designed to hold special plates and clips that would secure the rails to the guideway. After the concrete had set, steel plates similar in appearance to traditional tie plates, were placed over the studs. The tie plates had two parallel hollow lugs, each lug being adjacent to a side. Holes in the plates permitted the plates to pass over the studs. The plates were then bolted to the guideway. A small pad of rubber or neoprene was then placed over the plate between the lugs. The rails were then laid. The rubber pads were designed to absorb the sudden shock caused by the passing of a wheel on the rail. The lugs had been arranged so that the holes through them were aligned parallel to the rails.

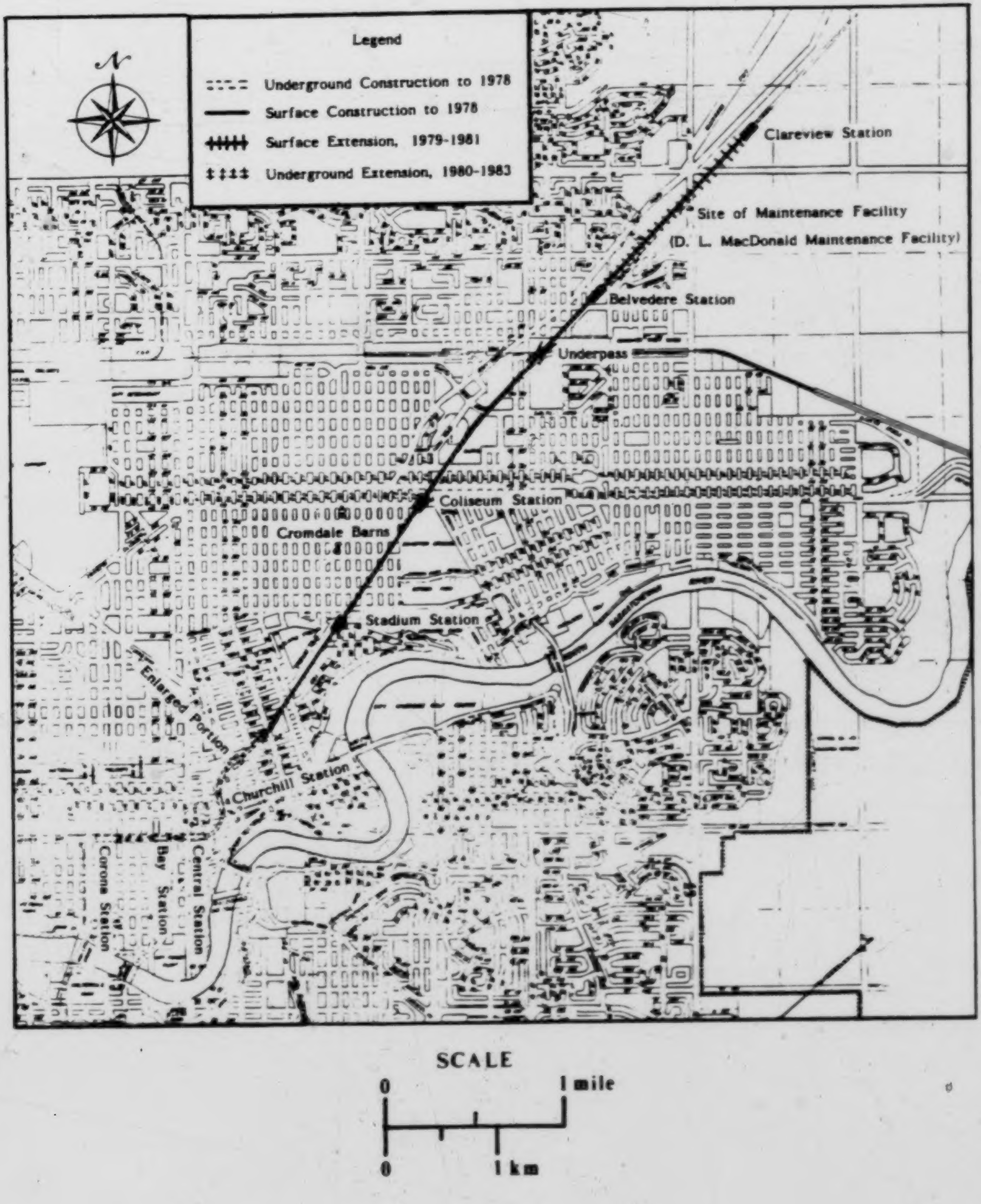
When the rails were in position, a hydraulically-operated unit passed by each lug and inserted a specially formed loop of spring steel into each lug. The spring steel loops, called "Pandrol clips", were shaped so that both ends of the loop rested against the plate, while the loop pressed tightly down on the top of the rail base. (Mainstream, October 6, 1977, p. 4, and Information from Con-Force Costain Concrete Tie Co., 1977) In this manner, the rails were semi-permanently secured in the tunnel sections. The lack of track spikes and organic ties meant that infrequent roadbed maintenance was required for these sections. In order to install the ribbon rails in the tunnels, the tunnel entrance near 95th Street had to be opened. It had been planned originally that 95th Street would pass beneath the LRT line by means of an underpass. Budget constraints prevented the construction of the underpass. It was, therefore, realized that the tunnel entrance was too close to 95th Street since the motormen of the LRT vehicles could not see the traffic approaching the 95th Street crossing until the LRT vehicles were at the crossing, by which time it would be too late for an LRT vehicle to make an emergency stop if necessary. In order to improve the visibility of the crossing from the tunnel, approximately 94 feet (28 651 mm) of the roof and the upper two-thirds of the tunnel walls were demolished. (Edmonton Journal, April 19, 1977, p. 16)

Excessive noise about the stations was a concern so a different method of track laying was adopted for these areas. The type of track construction selected was similar to the temporary track construction used for the ERR. (See Chapter III) The track areas of each station were underlain by thick rubber matting. Treated wooden ties were then placed on top of this matting. The rubber matting was intended to absorb noise and vibrations. The ties were treated with a phenol chloride solution rather than creosote because creosote usually produced an objectionable odor. (Roschlau, 1978, p. 17) Pandrol tie plates were spiked to each tie and the rails were placed in position. Pandrol clips were then installed by machine. Cleaned and crushed gravel ballast was then deposited along the spiked track from modified railroad hopper cars which were owned by the rail contractor, Loram International. A mechanical tamper unit then travelled along the track and raised and tamped the track until the correct height was attained. The mechanical tamper was able to do this with the aid of a trailing unit which projected two parallel laser beams. When both laser beams struck a target on the tamper unit, the raising and tamping of the track at that location was terminated. The tamper then proceeded and the process continued. (Mainstream, October 6, 1977, p. 4)

A double crossover was installed at the southern end of Churchill Station in order to enable trains to switch tunnels when required. The double crossover was the only piece of special work installed on the underground portion of the line. All of the underground trackwork was completed in the early months of 1978. (Author's Photographs) Map 17 (after Official Map of the City of Edmonton, 1975) shows the extent and the location of the underground construction completed in 1978.

Surface Construction, 1977-1978

The placement of the northeast LRT line facilitated surface track construction since the track was to be located along the centre of the CNR's right of way. (See Map 17) Sufficient room existed along the right of way for a double-track LRT line to be constructed. The construction method used was similar to a commonly used track construction method employed by the mainline railroads of that period. After the subgrade was graded and smoothed, a layer of crushed gravel was deposited to assist with track drainage. Creosote treated wooden ties were then placed in approximate position on top of the gravel. Common tie plates and 50 kg/m ribbon rails were then placed on top of the ties. The rails were set to the correct gauge and were spiked at every fourth or fifth tie. A track laying machine travelling along the roughly spiked track aligned each rail properly and spiked it to each tie. More gravel ballast


Legend
Underground Construction to 1978
Surface Construction to 1978
Surface Extension, 1979-1981
Underground Extension, 1980-1983
N
Clareview Station
Site of Maintenance Facility
(D. L. MacDonald Maintenance Facility)
Belvedere Station
Underpass
Coliseum Station
Cromdale Barns
Stadium Station
Enlarged Portion
Churchill Station
Corona Station
Bay Station
Central Station
SCALE
0
1 mile
0
1 km

MAP 17. LRT CONSTRUCTION, 1974–1983

was then deposited along the tracks and a mechanical tamper unit raised and levelled the track. (Mainstream, October 6, 1977, p. 4, and Author's Photographs) This type of track construction was less expensive than constructing a concrete guideway. In addition, it was believed that the track construction method used would keep the noise levels of LRT trains to a minimum. (ET Descriptive Brochure on the Transit System, 1977)

Several overpass bridges had to be constructed for this portion of the line in order to reduce the large number of level crossings with heavily-used streets. In addition, a large underpass had to be constructed beneath the CNR's main line near 66th Street. (See Map 17) The construction of the underpass was similar to the construction of the tunnel between Churchill Station and 95th Street. A drainage problem was encountered in the area of the underpass. Ground water had not been a problem in the construction of the underground section of the line since the water table lay several feet (m) below the level of the tunnels. The area around the underpass was somewhat swampy, however, and water tended to collect near the bottom of the underpass. In order to avoid the possibility of flooding, large electrically driven pumps were installed near the underpass. The pumps transferred any accumulation of water away from the underpass to adjacent storm sewers. The track construction through the underpass and its approaches was identical to the construction found in the tunnels, concrete guideways with Pandrol clips securing the rails. (Mainstream, October 6, 1977, p. 4, and Photographs in Author's Collection)

Special work on the surface portion included a right-hand crossover immediately east of 95th Street and another such crossover south of Coliseum Station. To enable the LRT vehicles to switch tracks at the northeast terminus (Belvedere Station), a left-hand crossover was installed immediately south of the station. The left-hand crossover south of Coliseum Station enabled LRT vehicles to reach the refurbished Cromdale car barns where the bus section constructed in 1946 had been converted for use by LRT vehicles. An interchange with the CNR was also installed at that location. (Author's Photographs) The Cromdale car barns, now referred to as the "Cromdale barns", could once again be used to store and to service railed vehicles after a 25 year hiatus. It should be noted that all switches, including those located underground, were normally operated by remote-controlled electric motors which were connected to the switches by means of rods and levers. Snow and ice were not allowed to accumulate near the switches. Special hot air switch heaters powered by propane were used to melt snow and ice from around the switches. Shaped steel heating ducts directed hot air from the switch heater's furnace to the area around the switch tongues and frogs. (Author's Photographs) Switch heaters were not required for the underground switches. The installation of the surface track was completed by the end of 1977. (Mainstream, October 6, 1977, p. 4) The extent of the surface track may be seen on Map 17.

The station buildings along the surface portion of the line consisted of concrete and steel structures which used corrugated steel and acrylic sheets for roof covering material. Access to the platforms was provided by underground tunnels which led to an area beneath the platform from entrances located to the side of the track area. Stairways, escalators and a single elevator enabled passengers to reach the platform from the fare collection area. The only exception to this design of station was Belvedere Station. This station was constructed in such a way that it did not cost as much as the other surface stations. Belvedere Station was located next to only one secondary rail line so it was felt that underground passageways were unnecessary. Treated wooden piles were used to support the concrete station platform instead of concrete piles that had been used in the construction of the other surface stations. Portable steel and acrylic shelters were placed on the platform instead of a more elaborate and expensive permanent enclosure. (Author's Photographs)

Signal System, 1977-1978

In order to avoid collisions between vehicles and other operational safety hazards, an elaborate signal system was installed on the line. The system was designed specifically for the line by the Siemens Company. (Author's Photographs) Each track was divided into several blocks which had block signals located near each end. Each block contained a low voltage electric circuit through the rails. Each block circuit was isolated from adjacent blocks. Each block was isolated from the next by means of special insulated bolted rail joints which were installed by cutting the rails at the points where the blocks began and ended. (See also Chapter IV for additional information)

The operation of the LRT system was arranged in a similar manner to double-track street railway operation. Outbound traffic used the southern track while inbound traffic used the northern track. The block signals, which were two lens, two color target signals, could display either a green light or a red light. The signals were mounted on short lengths of steel tubing which were held in place on concrete pedestals along the surface portions. In the tunnels, the signals were secured to the sides with bolts and steel brackets. The lamps of each signal were arranged vertically, with the red lamp being uppermost. Each signal was also given a number to assist with location. The number of the signal was displayed on a metal sheet which was affixed below the green lamp. (Author's Photographs) The signals were controlled either by a programmed computer or by a manual switchboard. Both the computer and the switchboard were located in the control centre which was located on the mezzanine level of Churchill Station. The control centre also housed the video monitors for the surveillance cameras as well as the radio apparatus for communicating with the buses and the LRT vehicles. (ETAR, 1979, p. 15) A panel marked with the track layout and lamps for each block showed the relative position of each train on the line. In addition to this apparatus, sensors and strong electromagnets were located in steel cases bolted to the ties between the rails near each end of each block. The sensors detected the presence of a train in addition to its speed. If a block signal displayed a red lamp or the train was travelling at excessive speed, an electromagnet within the case caused a contactor on the LRT vehicle to open which cut power to the motors, applied the brakes, and activated an alarm in the motorman's cab. This safety system reduced the probability of two LRT vehicles colliding and also reduced the likelihood of derailments caused by excessive speed. In addition to regulating train movement, the signal system blocks also activated the crossing gates at each level crossing. Some block signals were also equipped with two vertical yellow lights which were located below the green lamp. The yellow lights would flash alternately when certain conditions were met. The flashing yellow lamps warned LRT motormen that heavy vehicular traffic had recently been sensed at the crossing and the motorman should exercise extreme caution since there could be one or more motorists trying to use the crossing after the gates had descended. Sensitive panels installed in the surface of the road on either side of the crossing provided the controlling computer with information about the numbers of vehicles traversing the crossing within a specific time interval. If the computer determined that a heavy traffic flow existed, the flashing signal would be activated. (Author's Photographs and Observations)

Wiring for the signal system was placed in conduits that were secured to the sides of the tunnels in the underground portions of the line. Along the surface portions, the conduits were buried in trenches dug along the outside edges of the tracks. (Author's Photographs) In addition to the signal system, enclosed telephones were located along the side of the tracks at varying intervals. These telephones, designed to be used for emergencies only, were connected to the control centre. (Photographs in Author's Collection)

The construction of the initial part of the northeast LRT line was completed in early 1978 and free public rides were offered during April 18 through April 20. The official opening of the system took place on April 22, 1978. (Edmonton Journal, April 17, 1978, p. H1)

Surface Construction, 1979-1981

During 1979, the City Council approved the construction of a 2.2 km extension of the LRT line northeast from Belvedere Station to a new station to be called "Clareview Station". (See Map 17) Construction of the extension was begun before the end of 1979. (ETAR, 1979, p. 5)

The construction methods used for the extension were generally the same as the methods used for the initial surface portions of the LRT. Swampy areas located along the line of the extension required large amounts of earth fill in order to raise the subgrade above the water level. Special work on the extension included a right-hand crossover north of Belvedere Station, another right-hand crossover south of 137th Avenue and a left-hand crossover north of 137th Avenue. In addition, a temporary spur track was installed from the eastern track into the area of the site of the new LRT maintenance facility. (Author's Photographs and Observations) The spur track enabled special work trains to transport earth to the site from excavations beneath Jasper Avenue. (Author's Photographs)

The station at Clareview was constructed in a similar fashion to Belvedere Station. A substantial concrete and painted corrugated steel entrance and exit building was also placed at the northeast corner of the platform. This building housed the fare collection apparatus and led onto a bus loading area. (Author's Photographs)

Construction of the extension was completed in early 1981 and regular service on the extension began on April 26, 1981. (Edmonton Journal, April 27, 1981, p. B2) Map 17 (after Official Map of the City of Edmonton, 1975) shows the location of the Clareview extension as well as the site of the new LRT maintenance facility.

Underground Construction, 1980-1983

During 1979, the City Council gave its approval to the design and the construction plans of a new underground extension to the LRT system that was to travel from Central Station west beneath Jasper Avenue to a station located between 107th and 108th Streets. (ETAR, 1979, p. 5) Construction of the new 0.9 km underground extension began with the building of the stations in 1980. (Jasper Avenue Transitions, June 1983) Two stations were planned and both were to be located beneath Jasper Avenue. A short station was to be located between 103rd and 104th Streets and was to be called "Bay Station". The second station, located at the terminus of the line, was called "Corona Station". Corona Station was longer since it began between 106th and 107th Streets and ended halfway between 108th and 109th Streets. (Jasper Avenue Transitions, June 1983)

The construction methods used for the stations and the connecting tubular tunnels were basically the same methods that had been used in the construction of Central and Churchill Stations and the tubular tunnels connecting them together. (Author's Photographs) Spoil removal from the tunnel bores was facilitated by the use of specially constructed differential dump cars which were hauled by an electric locomotive to the spur track at the site of the new maintenance facility. The spoil was deposited at that location and was used as fill to raise the ground level above the water table. (Author's Photographs) The freight equipment will be discussed in the next chapter.

The track construction in the extension was similar to the construction used in the building of the original tunnels for the LRT. The wooden ties, rubber matting and gravel ballast were dispensed with for the stations, however. Concrete guideways with Pandrol clips were used in the station areas instead. Excessive noise with this track construction method did not appear to be a problem. (Author's Photographs and Observations)

The interiors of the stations at track level were finished with plated and polished metal strips which were attached to an elliptical steel framework that extended along both sides as well as the ceiling. This arrangement increased the amount of reflected light in these stations so that they did not appear as dingy as Central and Churchill Stations. The tiles covering the platforms were arranged in decorative patterns. In addition to fluorescent light fixtures, the new stations contained large vertical chandeliers which improved the esthetic appearance of the stations as well as improving the lighting levels. (Author's Photographs)

The construction of the new underground extension was completed by the end of May 1983 and regular service began on June 25, 1983. (Jasper Avenue Transitions, June 1983) Future underground and surface construction is planned but further extensions will be built when supplementary funding is provided by the Provincial Government.

Chapter IX

LRT Rolling Stock

Introduction

The previous chapter described the construction of an underground and a surface rail line which was intended to be used by high-capacity, electrically-powered vehicles. Unlike the defunct street railway, the tracks on the surface portion of the line were isolated from other vehicular traffic except at points where the line crossed roads (level crossings). (See Chapter VIII) The vehicles, therefore, could be much longer in length than traditional streetcars and buses since increased length would not affect the movement of other vehicles. The LRT system had been designed for platform loading, so the vehicles would not have to be equipped with steps which were difficult to manage by some passengers that had used streetcars, buses and trolley buses in the past.

Although Edmonton had terminated its street railway service in 1951, other Canadian and American cities had retained their systems and by the early 1970's were converting portions of their systems to LRT operation. Much of the rolling stock on these systems was obsolete or in need of replacement. In response to the need for new equipment, several North American manufacturers began to produce light-weight vehicles that: had a large passenger capacity, were the same basic shape as a streetcar, used traditional arrangements of electrical propulsion and control apparatus, and could negotiate the tight radius curves that were common on street railways. In order to be able to negotiate tight curves, these vehicles were usually manufactured in two main sections which were joined in the middle through a hinged coupling called an "articulation". North American manufacturers included: Boeing-Vertol in the United States, and the Ontario Transportation Development Corporation in Canada. (Newsletter, July/August, 1973, pp. 122-123, and March/April 1974, pp. 52-53)

High-capacity articulated streetcars and LRT vehicles had been manufactured and used in several European cities for many years. Rome, Italy, for example, received its first articulated streetcar in 1942. (Ogliari & Sapi, 1974, pp. 1298-1299) European manufacturers had, therefore, been producing high-capacity railed vehicles for many years by the time North American manufacturers began to produce such products in the early 1970's. The City of Edmonton, nevertheless, solicited bids for their LRT vehicles from domestic manufacturers as well as from offshore manufacturers.

Passenger Equipment, 1977

After the plans for Edmonton's first LRT line were approved in 1974, bids were solicited for the supply of a number of high-capacity, electrically-powered vehicles which were suitable for both the underground and the surface portions of the line.

The North American builders had recently received orders for LRT vehicles from other cities in the United States but no vehicles had been constructed by the end of 1974. (Newsletter, July/August, 1973, pp. 122-123) No North American LRT vehicle, therefore, had been proven in service. The most promising bid came from the West German builder Waggonfabrik Uerdingen or "Duewag" as it was popularly known. Duewag proposed to supply a number of three truck, articulated vehicles which would be similar in appearance and construction to their type U2 vehicles that had been recently supplied to the West German City of Frankfurt.

(Letter to the City of Edmonton Finance Department from Duewag, September 20, 1974) The vehicles were to be arranged for double end operation, a similar arrangement to the first streetcars ordered for the ERR in 1908. The motive power was to be provided by two large D.C. motors with series-parallel control operated by an electronically-governed camshaft controller system. The electrical apparatus was to be supplied by the German Siemens Company which had supplied other electrical apparatus to the City in the past. (Letter to City of Edmonton Finance Department from Duewag, October 8, 1974)

Duewag had been producing articulated LRT vehicles for many years and that company had a favorable reputation in many European cities. An additional attraction to the Duewag proposal was the possibility of having some of the assembly work undertaken in Edmonton. If this were done, the import duty on the vehicles could be reduced. (Letter to City of Edmonton Finance Department from Duewag, September 20, 1974) Considering these points, the City ordered 14 LRT vehicles from Duewag in November 1974. (See Appendix I)

The new LRT cars for Edmonton were given the designation RTE1 since they were to contain several differences that would distinguish them from the U2 type vehicles on which they were based. (Letter to Rapid Transit Project from Siemens, January 5, 1975) Each type RTE1 car consisted of two long body sections that were joined at one end over an articulation which was supported by an unmotorized truck. Each body section contained a control cab and was supported near the cab end by a motorized truck. Each body section was approximately 1 100 mm in length and both body sections were constructed in a similar fashion. (Duewag Specifications of Rapid Transit Car, 1978, p. 5) It should be noted that since these vehicles were fabricated, for the most part, in

West Germany, the Système International d'Unités (SI) measurements were used exclusively. Unlike the defunct streetcars (but like most modern trolley and motor buses), each LRT body section was fabricated as an integral unit. All the underframing consisted of light-weight rolled and hollow steel sections that were arc welded together. The bottom of the underframing was strengthened near the ends for the installation of couplers. Small bulkheads were installed at each end in order to prevent any twisting of the sides. The bulkheads were small, however, and they did not interfere with the movement of passengers within the interiors of the cars. Except for the cab ends, the body sections were sheathed with sheet steel. Wood and canvas were no longer considered to be suitable building materials for such vehicles. The side panels consisted of steel sheets that were 1.5 mm thick, which were welded to the side framing. Above the windows and on the roof, sheet steel of 1.25 mm thickness was used since these areas were usually high enough to avoid any blows. The cab end of each body section was fabricated of fibreglass. The fibreglass unit was attached to the steel framing of the car section by means of screws. The fibreglass unit was designed for easy replacement and contributed to reducing the total weight of the car. (Duewag Specifications, 1974, p. 2)

The flooring in each section consisted of 16 mm thick waterproof plywood which was secured to the underframing with screws. The sides of each body section were framed for four large windows, two folding door sets, and a small rectangular window in each side of the motorman's cab. The interior sheathing above the windows as well as the ceiling panels consisted of white painted fibreglass panels. The panels were joined together by means of "H" section extruded aluminum moldings which were painted to match the color of the panels. The ceiling panels were designed to support lighting fixtures and contained numerous small slots which permitted air within the car to enter ducts inside the ceiling, which directed the air to roof-mounted exhaust fans. The wainscoating on these cars consisted of carpet-covered melamine panels. In addition, the back of the motorman's cab, facing the interior of the vehicle which contained a single outwards opening door on the right-hand side and a fixed rectangular window on the left, was also sheathed with melamine. (Duewag Specifications, p. 6)

The spaces between the interior and the exterior sheathing were insulated. A 15 mm layer of fibreglass insulation was installed between the roof and the ceiling, while the insides of the exterior panels were coated with two layers of a bitumen compound and a single 2.5 mm thick layer of "Schallschluck 301 DC", which was a polymerized material that absorbed noise and minor vibrations. It should be noted that the underside of the body sections also received a 2 mm thick application of the sound absorbing compound. (Duewag Specifications, p. 3)

The door leading to the motorman's cab contained a small fixed rectangular window which was similar to the window installed on the left-hand side of the partition separating the cab from the rest of the interior. The door to the cab was normally kept closed by means of a spring latch. A handle on the side of the door facing the interior of the cab enabled the motorman to close and open the door easily from the cab. The latch could be opened from the interior of the car by means of a special square wrench or key which was supplied to each motorman. (Author's Observations) This arrangement provided some security to the cab area and to the motormen.

The interior of the motorman's cab housed the necessary apparatus required to control the various systems of the vehicle. The ceiling of the cab also contained two small air vents as well as an access panel to the destination roller sign and its illuminating lamp. (Duewag Specifications, p. 6) The front of each cab contained two angled windshield sections and a single elliptical glass panel above the windshield sections which covered a single roller sign. The windshield sections were angled to reduce reflections on the interior surfaces of the windshield sections at night. The windshield panes consisted of tinted thermic insulated safety glass which contained an electric heating grid on the interior surface. (Duewag Specifications, p. 7) The wire grid was connected to a power supply and was intended to heat the windshield sufficiently in cold weather to remove any condensate or frost. Large pull-down shades were installed in the cab behind each windshield section to provide the motorman with protection against direct sunlight and glare. It was mentioned previously that a small rectangular window was located in each side of the cab. These windows not only permitted the motorman to see to the sides, but the upper halves of both windows could be slid down to provide the motorman with additional air. (Duewag Specifications, p. 7)

The large side windows were sealed in place with rubberized molding along the edges. The upper quarter of the windows, which were framed with extruded aluminum, were hinged along the bottoms and could be pulled open to allow air to enter the interior of the car directly. This design of window prevented passengers from sticking appendages outside. Each doorway was 1 300 mm wide by 1 900 mm high. Two Duewag fibreglass folding door halves were installed in each doorway. The doors were operated by an electro-mechanical drive mechanism which was located in a compartment in the interior of the car located above the doorway. The power for the door mechanisms was controlled by a switch on the motorman's control panel, while the opening and the closing of the doors was controlled by the passengers. A stanchion mounted in the centre of each doorway on the inside of the car held a push button switch in addition to a small steel enclosure above it which contained an acrylic panel. When the operator activated the door circuits, an incandescent lamp inside the enclosure was activated. The light illuminated a sign on the inside of the acrylic panel which read "doors open" in addition to a small arrow which pointed down to the push button switch. By pressing the switch, the passenger closed a circuit to the door opening motor and both door halves opened. A push button was also mounted next to the door on the outside of the car to enable passengers to enter the car. The centre doors on each car section had two push button switches on the exterior, one near each side of the doorway. These exterior push button switches did not have an illuminated panel above them to indicate when power to the door opening circuit was present. Instead, the button was illuminated inside by a small incandescent bulb when the door opening circuit was energized. A time delay feature in the door mechanism kept the doors open for approximately 3 seconds after they were fully open. When the doors were either in the open or the closed position, solenoid operated pins kept the doors in that position. The solenoids were located in the mechanism compartment above the doorway. It should be noted that this compartment also contained two handles which could be turned in the case of an emergency. This action released the solenoid locking pins which enabled the doors to be opened manually.

Each door half was equipped with a sensitive edge that would cause the door to reopen if the edge struck an object while closing. Unlike the sensitive edge strips installed on the early trolley buses in Edmonton, the new sensitive edge strips did not contain wires. In order to eliminate the adjustments necessary with wire sensitive edge strips, a rubber strip was used which contained a sealed hollow capillary tube running longitudinally. Pressure on the capillary tube compressed the air inside it. A sensor switch mounted near the top of the strip reacted to the increased pressure by closing a circuit which reversed the power to the door motor, thus reopening the door. (Duewag Specifications, p. 4) In addition, each door half was also equipped with a photo-electric cell which received light from a small lamp mounted on the stanchion in the centre of the doorway, the same stanchion which held the push button switch. The photo-electric cell was located near the bottom of the door in order that the shortest of passengers would be protected. The photo-electric cell functioned in a similar manner to the sensitive edges, by reversing the power to the door motor if the light beam was interrupted. It should be noted that at each stop the doors would open only if a passenger either inside or outside the car pressed one of the push button switches. The push button switch only opened the particular door immediately next to the switch. (Duewag Specifications, p. 4) This arrangement prevented excessive heat loss from the interiors of the cars. An additional door feature enabled the motorman to activate the door circuits on the doors located immediately behind the cab. (Duewag Specifications, p. 4) This feature enabled the car to unload and to pick up personnel at small platforms located near maintenance facilities.

The floors of the interior were covered with a tight-weave carpet material which was treated with compounds to resist moisture and soiling. The floor areas around each door, however, were covered with a rubber matting which had regularly spaced circular protrusions on its surface. The matting was intended to provide a slip-free surface for passengers entering or leaving the car. (Author's Observations) Except for the stanchions in the centre of each doorway, Duewag did not install the remaining stanchions or any seating. The seating, which was to consist of several cross seats arranged in compartment fashion, one cross seat facing another, was to be fabricated in Edmonton. (Edmonton Journal, April 13, 1977, p. 51) This seating arrangement was well suited for double end operation of the LRT cars since some of the seats would always be facing in the direction of travel. The stanchions not installed were supplied, however. The stanchions were designed to fit into aluminum holders that were secured to the framing above the ceiling. The bases of most of the stanchions were designed to fit into similar aluminum holders which were secured to the tops of the seats. With this arrangement, legs underneath the seats were not required since the ends of the seats adjacent to the aisle would be supported by stanchions. The stanchions were composed of steel tubing which was covered with a plastic coating referred to as "Kautex". This coating not only provided a sanitary surface on the stanchion, it also insulated the stanchion from any electric currents. Smaller vertical grab handles were supplied for both interior walls of the articulation. Grab handles were also supplied for the partition walls separating the interior of the car from the cab. (Duewag Specifications, 1974, p. 7)

One of the two body sections held the current collection apparatus which was installed on the roof near the rear of the section (the end opposite the cab). The current collector consisted of a half pantograph which was raised by means of springs and was lowered by an electric motor and gear arrangement. A description of the current collector and its operation were included in Chapter IV. In order for the half pantograph to be insulated from the roof and in order for it not to damage the roof at that location, the pantograph was mounted on boards which were fixed to the roof. These boards were similar in appearance to the trolley boards installed on the Edmonton trolley buses. (Duewag Specifications, p. 3, and Author's Observations)

The body section that was fitted with the current collector was designated the "A end" of the car, while the other section was known as the "B end". (Duewag Specifications, p. 3) The open ends of both sections were semi-permanently connected to an articulation. The articulation rested on a single unpowered truck and consisted of an inverted "U" shaped frame or yoke which was bolted to a floating bolster which rested on springs supported by the truck sideframes. A circular turntable in four parts was also attached to the bolster. Steel members attached to each body section were secured by large pins to the underside of the turntable. The turntable not only permitted each body section to turn independently of the other, it also permitted vertical movement of each body section as well as the articulation. This arrangement reduced the stresses between the body sections and the articulation and reduced the likelihood of derailments. A roof-mounted guide rod assembly connected the roof of each section with the top of the articulation. This guide rod as well as the turntable kept the two body sections spaced a constant distance apart. The articulation frame, which was sheathed with fibreglass, was necessarily smaller than the sides of both body sections in order to permit unobstructed lateral and vertical movement of the three car components. In order to keep dust and the elements from entering the interior of the car through the articulation, flexible rubber sections were attached to the bulkheads of each body section and to the articulation frame. The rubber sections were hidden from view on the exterior since the articulation frame extended inside the body sections a few millimetres. Carpet covered fibreglass panels installed on the inside of the articulation frame prevented the rubber sections from being seen from the interior of the car. (Duewag Specifications, p. 3)

Each RTE1 type LRT car assembly was supported by three two-axled Duewag trucks. Both the powered and the unpowered trucks were similar in appearance and both were fabricated of steel. The sides of the Duewag trucks were somewhat similar in appearance to the Bemis type 45 trucks which were used on some ERR streetcars but there was no further similarity between the Duewag trucks and any streetcar truck used on the ERR. The Duewag trucks consisted of two sideframes and two truck bolsters which were fabricated as a single integral unit, thus eliminating many individual frame parts and their requisite fasteners. The end of each axle was supported by a roller bearing journal box. Instead of the sideframes resting on coiled springs placed on top of the journal boxes, primary suspension was provided by heavy rubber blocks which were attached to the sides of the journal boxes. Both the sides of the journal boxes and the corresponding slots in the sideframes were tapered so that the rubber blocks were tightly wedged in the sideframes. The blocks were resilient enough to permit some vertical journal box movement but were not soft enough to allow uncontrolled axle movement. A rod placed through the sideframe beneath the journal box prevented the journal box from dropping out from the sideframe slot. (Duewag Specifications of Rapid Transit Car, 1978, p. 5) The use of rubber blocks instead of springs meant that noise as well as vertical movements would be dampened.

The wheels on each axle were significantly different from the wheels used on the ERR streetcars. It should be recalled from Chapter V that one of the major complaints made against streetcars was the excessive noise made by the wheels travelling along the rails. Newer streetcars introduced during the late 1930's employed a system whereby a flanged steel tire was attached through a layer or layers of stiff rubber to a steel hub which was attached to the axle. (Thompson, 1940, pp. 50-148) This type of composite wheel was used on the Duewag trucks installed on Edmonton's 14 RTE1 LRT cars. The diameter of the wheels when new was 720 mm, a much smaller diameter than any wheel used on the ERR. (Siemens Specifications of Electrical Equipment, 1975, p. 2)

Each axle on both the powered and the unpowered trucks contained a large ventilated brake disc. A brake caliper was provided for each brake disc and was bolted to a lug welded to one of the truck bolsters. (Author's Photographs) The brake pads in the calipers were forced against the brake disc by means of strong coiled springs. The brake pads were normally held away from the brake disc by means of large holding electromagnets. The pads were withdrawn from the disc by means of an electric resetting motor and gear assembly. It should be noted that these spring operated disc brakes comprised only part of the vehicle's braking system. (Siemens Specifications, p. 12)

Both sideframes of each truck held magnetic track brakes which were bolted to the bottoms of the sideframes and which were positioned over each rail. Each track brake consisted of a large electromagnet which was enclosed in a steel housing. When energized, each track brake could exert a force of approximately 55 kN on the rail. The six magnetic track brakes on each car were used for emergency braking only. (Siemens Specifications, p. 3) It should be understood that magnetic track brakes were not a new innovation. This type of brake apparatus had been used on many types of streetcars since the early 1920's. (Dover, 1929, pp.

371-373)

The trucks were attached to the body sections and to the articulation by means of a floating steel bolster and a large diameter ball bearing race. Two steel coiled springs mounted on the top of each sideframe near the centre supported the steel bolster. The bolster, in turn, held a large diameter steel ring which held several bearing balls in small slots. This ring comprised the bottom of the bearing race. Another ring was bolted to the underframe of the car at the desired location of the truck. The car was lowered onto the truck and the rings interlocked. Hydraulic shock absorbers were then connected between the truck sideframes and the floating bolster to further dampen any vibrations and shocks. (Duewag Specifications, 1974, pp. 9-14) This truck mounting arrangement eliminated much of the turning friction and the lateral motion encountered by streetcars which were attached to their trucks by means of kingpins and side bearings. (See Chapter V)

Each Duewag truck had steel semi-circular mud guards installed over the upper half of each wheel. These guards, which were bolted to the sideframes, prevented moisture, sand and mud on the rails from being thrown up into the truck or the motor. The exterior of each truck was also surrounded by an arrangement of narrow steel bars which were bolted to the sideframes and which served as a lifeguard (fender). (Duewag Specifications of Rapid Transit Car, 1978, p. 4) This arrangement was practically identical to that provided for the Brill 21-E truck installed on ERR streetcar Number 7 in 1908. (See Chapter V) That arrangement was found to be woefully inadequate since that lifeguard could and did enable a person to be crushed and killed by the streetcar. It should be recalled from Chapter V that the ERR's fleet of streetcars was re-equipped with a better form of lifeguard (the Hudson-Bowring type) as the result of the inadequacy of the original apparatus.

The LRT cars were equipped with gravity feed sanders which were controlled by solenoid operated valves. Sand was distributed in front of the leading axle and in front of the second to last axle, as seen in the direction of travel. The purpose of the sand was to increase wheel adhesion during certain accelerating and braking maneuvers. The sand boxes, which were fabricated of steel plate, contained an inner liner of wood to reduce corrosion inside the box. The sand boxes were placed under seats in the interior and were located above each powered truck. The sanding tubes leading to the rails were attached to the truck lifeguard and were joined to the sand box outlet pipe by means of a length of rubber hose. The sand boxes were usually filled from hatches which were located on the exterior of the car below the windows. The sand boxes could also be filled from the inside of the car if necessary. (Duewag Specifications, 1974, p. 8)

Although single LRT cars could operate without difficulty, their electrical and control systems were designed so that up to five cars could be coupled together and operated from either one of the end-most cabs. This arrangement was referred to as "multiple unit operation" or MU. (Siemens Specifications, 1975, p. 1) In order to join the cars together, a reliable coupling system had to be used. The Duewag cars were equipped with a Scharfenberg coupler which was centered at each end. Heavy steel piping was attached to a pivot which was secured to a strengthened portion of the underframing. The coupler head, which was mounted on a smaller diameter steel rod, was slid into the piping. A system of flanges and coiled springs kept the coupler head attached to the pipe stalk while allowing the head to move longitudinally when it was struck.

The Scharfenberg coupler head was rectangular and contained a tetrahedral-shaped protrusion on the left-hand side and a similarly-shaped depression on the right-hand side. In coupling operations, the cars were moved together so that the protrusions on each coupler entered the depressions of the other. When the protrusions had entered the depressions, a small lever near the end of each protrusion was depressed. This action released a locking pin in the protrusion which prevented the protrusion from being pulled out from the other coupler. A switch inside the motorman's cab enabled the cars to be electrically uncoupled. The switch closed a circuit to an electric motor which drew the locking pin into the protrusion. In order to be able to operate all coupled cars from one cab, the electrical control circuits had to be connected together as well. This operation occurred simultaneously with the coupling of the cars. A Faberg lug type electrical connector was mounted on the top of each coupler head. The lugs of each connector were normally protected by a sheet steel cover. As each coupler came together, levers deflected by this action caused the connector covers to pivot upwards out of the way. The connectors were joined as the couplers were fully connected. (Duewag Specifications, p. 8) In this manner, the individual LRT cars could be coupled together and operated from one control position.

It has been mentioned previously that Siemens provided most of the electrical equipment for these vehicles. Each LRT car was powered by two Siemens box frame, series wound, self-ventilated motors which could each produce a maximum continuous output of 150 kW. (Siemens Specifications, p. 4) Each motor was mounted longitudinally on its respective truck. The trucks nearest the cab end of each body section were powered. In order to power both axles of the truck, a heavy-duty bevel gear hypoid differential was installed on each axle. This was accomplished by the installation of a hollow pipe along a short distance of the axle. The pipe, which was an integral part of the differential, contained a flange at each end which had evenly-spaced square notches cut along the circumference. These flanges were designed to be connected to similar flanges which were secured to the axle. Each pair of flanges was designed to interleave the square teeth along the circumference. Small spaces existed between each tooth, however. These spaces were filled with stiff rubber wedges. This arrangement served several purposes. Firstly, the flanges transmitted torque from the differential pipe to the axle. Secondly, the rubber wedges absorbed most of the noise and the vibrations produced by the differential gears and by the motor. In this manner, such noise and vibrations were isolated from the truck frame and the body of the LRT car. Thirdly, the flange arrangement facilitated the replacement of the axle or the differential without having to dismantle the differential while it was attached to the axle.

Each differential contained a large crown or "bull" gear which was bolted to a flange attached to the differential pipe. A hypoid pinion gear was held at right angles to the crown gear by the differential housing. The housing enclosed the gears and also contained the necessary lubricating oil. The pinion gear shaft, at the end facing the motor, was hollow and contained internal splines. The differential housing also contained a large flange near the end of the pinion gear shaft. This flange was designed to hold one end of the motor. It should be noted that the differential on the opposite axle was arranged so that the crown and the pinion gears were arranged backwards in relation to the differential on the opposite axle. With this arrangement, the rotation of the motor would revolve both axles in the same direction. Each end of the motor contained a short length of splined shaft as well as eight studs which were designed to secure each end of the motor to a differential. (Siemens Specifications, 1978, p. 5) This arrangement enabled the motor to be securely mounted to each differential which, in turn, transmitted torque to both axles of the truck. Power to the motor windings and the armature was provided by several insulated cables which could be disconnected from the body of the LRT car. In order to prevent electrical damage to the various bearings on the trucks, the return current was fed directly to the axles from flexible wipers which rested against the axles. (Siemens Specifications, 1974)

The motor control equipment on these LRT cars was a combination of: the series-parallel control that had been used on the ERR streetcars; the camshaft controller and contactor system that was used on some of the older ETS trolley buses; and solid state monitoring and governing devices which were similar to some of the apparatus found on the Brown Boveri trolley buses. Fully electronic "chopper" control was not used on these LRT cars.

The cabs of each type RTE1 LRT car each contained a key-locked direction and operation control drum and a combination control and braking handle which was called a "command transmitter". The handles for both units were located at the top of a cabinet to the left of the operator. This layout was similar to that found on the ERR streetcars for the controller. The movement of the direction and operation control drum energized the command transmitter handle. In addition, the control drum selected the direction of travel and recovery from operational faults, such as releasing the dead-man feature too long or attempting to run the car through a red signal. (Siemens Specifications, 1975, p. 6)

The handle of the command transmitter was connected by small gears to a low-voltage magnetic field potentiometer (variable resistor). This type of potentiometer does not contain any parts which slide across each other, thus reducing the frequency of service for the unit. In the neutral position, the handle of the command transmitter was positioned vertically. Pushing the handle forward provided increasing voltage to a small motor and to electronic monitoring circuits which were connected to the controller's camshaft. Pulling the handle back from the neutral position not only caused the controller shaft to be returned to the "off" position, but the action caused the controller's camshaft to be rotated to the braking positions. This arrangment eliminated any mechanical linkage or high voltage connection between the controller and the command transmitter. (Siemens Specifications, p. 6) The controller was located in a compartment on the lower left-hand side of the A section of the body. The accelerating and braking rheostats were divided into two groups, each group being located in a steel cabinet mounted on the underframe beneath the floor of each body section. Electric blowers connected to each cabinet provided air to cool the rheostats. (Siemens Specifications, p. 6)

The operation of the camshaft controller was similar to the operation of the type of camshaft controllers installed on the Mack, Pullman-Standard and Canadian Car and Foundry trolley buses. Instead of using a separate bank of contactors, the Siemens controller incorporated the contactors in the controller's frame. Since there were two motors on each LRT car, series-parallel control could be used. The Siemens controller employed 11 series and 9 parallel steps or notches. Additional motor speed was achieved in the last two parallel steps by the reduction of the voltage (excitation) to the motors' field coils. This arrangement enabled the LRT cars to attain a maximum speed of 80 km/h. (Siemens

Specifications, pp. 5-9) The command transmitter did not entirely control the speed at which acceleration and braking took place. An electronic device referred to as a "Simatic running and braking regulator" monitored: wheel slip on the rails, the jerking of the car body during accelerating and in most braking, and the position of the controller's camshaft. The Simatic unit was located inside the A body section in a steel cabinet placed beneath one of the seats. The Simatic unit regulated the speed at which the controller's camshaft was rotated in order to provide the smoothest and the most efficient accelerating and braking speed. It should be noted that if the unit sensed wheel slippage, for example, the solenoids on the sand boxes would be energized and sand would be deposited on the rails. In addition, the speed of acceleration would be retarded until normal wheel adhesion was recovered. (Siemens Specifications, pp. 8-13)

Dynamic braking was the primary braking system on these LRT cars, the amount of braking being determined by the position of the command transmitter and the various circuits of the Simatic unit. When the dynamic braking had slowed the car to a speed of approximately 5 km/h, the Simatic unit cut the power to the electromagnets holding the calipers of the spring actuated disc brakes open. The disc brakes, therefore, were used to bring the car to a complete stop. (Siemens Specifications, p. 10) The only time that the disc brakes were not used during braking was during an emergency brake application. In such a maneuver, all six electromagnetic track brakes were activated. In addition, the controller was immediately returned to the "off" position and the line breakers were opened. It should be noted that features such as the jerk detection circuits were removed from operation in order to enable the car to be stopped in the shortest distance possible. (Siemens

Specifications, p. 12) It should be realized by this point that these LRT cars did not contain any sort of air brake equipment, nor did they use any apparatus that required compressed air. This arrangement eliminated elaborate and costly compressed air systems. The braking systems described previously were thought to be satisfactory. Air brakes, therefore, were considered obsolete and unnecessary.

Several operational safety features were included with these vehicles. In the event of a car inadvertently uncoupling while in operation, the spring actuated disc brakes on the uncoupled car were immediately activated. This action would bring the car to a safe stop in a short time. Each cab on each LRT car contained a dead-man feature which was designed to stop the LRT car if, for any reason, the motorman became incapacitated and could no longer control the car. Either a foot switch located in the cab or a hand switch located on the right-hand side of the motorman's indicator console had to be depressed at all times when the car was in motion. If no switch was depressed for more than approximately two seconds, maximum dynamic braking was instigated. This braking could be cancelled only if the motorman depressed the hand switch and moved the handle of the direction and operation control drum. (Siemens Specifications, pp. 10-12) It was mentioned in Chapter VIII that the signal system on the LRT line contained track-mounted electromagnets which would cause power to the motors to be cut if an LRT car attempted to pass a red signal. The car would be stopped because the electromagnet between the rails would cause the line breakers on the car to open and would send a signal to the Simatic unit to apply full dynamic braking. (Siemens Specifications, p. 10)

Trolley voltage was not suitable for all the electrical apparatus on these LRT cars. Voltage of this type and magnitude was inappropriate for: the electronic control equipment, the door operating motors, the headlights and other exterior lamps, and the interior lighting. A low voltage power supply was required. In order to reduce the cost of the apparatus necessary to produce the low voltage, each LRT car was equipped with a motor generator which was manufactured by the West German firm, Lech Motoren. The motor of the unit, which was powered by trolley voltage, was rated at 6 kW maximum output. (Siemens Specifications, 1978, p. 5) The generator produced two regulated output voltages, 220 volts A.C. and 22.5 volts A.C., both at a frequency of 100 Hz. (Siemens Specifications, 1974, p. 11) The 220 volt supply was used to power the interior fluorescent lamps as well as several roof-mounted ventilator fans. The 22.5 volt A.C. supply was used to heat the windshield heating grids. The power was also directed through a solid state rectifier which produced an output of 24 volts D.C. This voltage was used to charge a lead acid storage battery. The 24 volt D.C. system powered: the control equipment, the head and tail lights, the door motors, the disc brake resetting motors, the holding electromagnets, the magnetic track brakes, and other electrical accessories. (Siemens Specifications, 1974, p. 11) It is perplexing to understand why 220 volts was selected as the voltage for the interior lamps. Although 220 volts A.C. was common household current in many European cities, that voltage was not widely used in Canada. In addition, many motor and trolley buses in the ET fleet used fluorescent tubes as well. The supply voltages for the tubes on those buses was 110 volts A.C. produced by a transistorized unit. (See Chapter VI) It should be noted that 100 volts A.C. was also the common household voltage in Edmonton.

Although motor generator sets were used by Edmonton trolley buses in the past, their use was becoming rare because of the predominant use of solid state inverters and rectifiers which contained no moving parts. It should be recalled that the Brown Boveri trolley buses had been equipped with a solid state inverter and rectifier unit. (See Chapter VII) The major disadvantage of a motor generator was that it contained several moving parts in addition to several carbon brushes that required periodic replacement. Solid state units, however, did not contain any moving parts and did not require periodic maintenance. Solid state units usually had a much longer maintenance free period than mechanical motor generators. It is possible that the motor generators on the LRT cars will be replaced by solid state units when it is discovered that the units have increased maintenance and labor costs.

The cab end of each body section contained a control console for the various auxiliary circuits in the car. The console, which contained an array of switches and indicator lamps, was installed directly in front of the motorman's seat and was designed to be at a convenient height when the motorman was seated. The console was fabricated of painted steel and was angled upwards beyond the centre. Some of the indicator lamps and switches, therefore, were on the flat portion of the console while other switches and lamps were located on the angled portion. The console contained a speedometer and a battery state of charge meter as well as four rotary switches. These switches controlled: the windshield wiper motors, the cab defroster/heater fan, the side selector switch for the doors, and the operation of the public address system. In addition, the console contained several rectangular illuminated push button switches and similarly shaped indicator lamps. The switches controlled the: raising and the lowering of the pantograph, opening and closing of the line breaker, manual operation of the sanders, headlights, activation of the door opening switches, warning horn at that end of the car, operation of the coupler at that end of the car. A special series of switches located at the extreme right-hand side of the console enabled the motorman to bypass a red signal in certain emergencies. The indicator lamps revealed any faults in the various electrical and mechanical systems in the car. It is important to note that the control console was designed by Siemens in conjunction with the City of Edmonton. Except for the rotary switches, the function of each switch and indicator lamp was provided by pictograms which were etched and colored onto the top of each switch and indicator lamp cover. (Siemens Specifications, 1978, p. 4) The use of pictograms instead of labels made the control console appear uncluttered and easily understood.

It was mentioned previously that the motor generator unit provided the power for both the interior and the exterior lighting. The interior lighting consisted of two parallel strips of fluorescent tubes which were installed on the ceiling of each body section. Each strip contained seven fluorescent tubes. The tubes were covered by an opaque acrylic light diffuser. The wiring of these circuits was designed so that in the event of a failure of the motor generator, four fluorescent tubes in each car section would remain illuminated by a solid state converter which was powered by the 24 volt D.C. battery. The interior of the motorman's cabs were illuminated by two small ceiling spot lamps which were powered by the 24 volt D.C. supply. (Duewag Specifications, 1974, p. 7, and Siemens Specifications, 1974, p. 14) In addition to the door push button bulbs, the exterior lighting included: two automobile-type sealed dual beam headlights which were installed at each end of each car; four small red combination tail lights and reflectors which were installed at both ends of each car next to the headlights; and amber colored operation lamps which were installed on the sides of the car near each door nearest the cab ends. The operation lamps were illuminated when the car was stopped and all control drums were set to the "off" position, but all major power systems were still active. The lamps were also illuminated during an operational fault. These lamps could indicate potential problems to observing personnel. (Siemens Specifications, 1974, p. 14) Other electrical apparatus included a public address system. This transistorized unit enabled a motorman or a tape recording to make announcements to the passengers inside the car. A microphone, mounted on a flexible shaft which was attached behind the control console, enabled the motorman to use the system. The motorman could also address passengers standing on the platforms, since each car was equipped with roof-mounted loud speakers which could be activated by one of the rotary switches on the control console. The amplifying equipment was located in the interior of the B body section in a steel cabinet which was located underneath one of the seats. The interior speakers for the system were located inside compartments in the bulkheads of each body section near the articulation. (Siemens Specifications, 1974, p. 17, and 1978, p. 2)

A small electric horn was installed at each end of the LRT cars. The horn, which was located underneath the floor of the cab near the coupler, was activated by a push button switch located on the control console. (Siemens Specifications, 1974, p. 18) The horn produced a high-pitch tone and was easily confused with an automobile horn. Most pedestrians and motorists did not readily associate the sound of that horn with an LRT car. (Author's Observations) Each windshield section was equipped with an electrically powered vertical wiper. The wipers could be set for continuous or intermittent operation. (Siemens Specifications, 1974, p. 18)

The heating of the interior during cold weather was accomplished in a similar manner to the heating of the ET trolley buses. A duct leading from each rheostat compartment to floor ducts in each body section enabled the heated air from the rheostat cabinets to enter the interiors. Supplementary heat was provided by two 16 kW auxiliary heating elements which were located in the rheostat compartments. A solenoid controlled damper could direct the heated air to the interior ducts or it could direct the air to exterior exhaust vents. The operation of the solenoid dampers as well as the auxiliary heaters were controlled by thermostats located in the interior of the car. The heating system incorporated a safety feature. In the event of a power interruption to the solenoid, the solenoid would return to its rest position, which caused the damper to direct the heated air to the outside. In this way, the interior could not be inadvertently overheated. (Siemens Specifications, pp. 13-14) Ventilation through the interior was provided by roof mounted exhaust fans which were connected to the ceiling ventilator ducts. The fan motors were powered by the 220 volt A.C. supply. (Siemens Specifications, p. 15) The fresh air intakes consisted of louver vents which were located in the exterior sheathing near the bottom of the body. (Duewag Specifications, 1974, p. 8)

In addition to the heated window panes, each motorman's cab was equipped with a 3 kW electric heater which was controlled by a thermostat. The heater, which operated from trolley voltage, also served as an auxiliary defroster for the windshields. (Siemens Specifications, p. 13) Two small ceiling-mounted ventilation fans in each cab provided air circulation inside the cab. The fans were each powered by a motor which operated from the 24 volt D.C. supply. (Siemens Specifications, p. 15)

Each LRT car was also equipped with an external rear view mirror on each side of each cab. The mirrors, which could be pivoted, enabled the motorman to observe the boarding and the unloading of the cars under his or her control. (Duewag Specifications, 1974, pp. 9-10)

The exteriors of the LRT cars were painted white at the factory and were coated with a protective wax to prevent damage from salt water spray on their sea voyage to Canada. Each car was shipped disassembled, the trucks and the articulations being shipped in sealed containers. (Edmonton Journal, April 6, 1977, p. 1951) The only exception to the painting was the first unit which also received ET's blue and yellow stripes as well as the ET insignia. This unit was fully assembled in Germany and was tested on a street railway before it was dismantled and shipped to Edmonton. (Duewag Specifications, 1978, p. 1)

The first units arrived in Edmonton during March 1977. Upon their arrival, the cars were transported to the Cromdale barns where they underwent the final fitting by Siemens Canada Limited. The cars were then painted and numbered. (Mainstream, March 30, 1977, p. 1)

The seating for the LRT cars was manufactured in Edmonton by two companies: Oxford Machine and Welding which fabricated the sheet steel seat frames; and Apex Auto Upholstery which fabricated the seat backs and cushions. (Edmonton Journal, April 13, 1977, p. 51) One end of each seat was supported by a steel ledger which was attached to the side of the car, while the other end of the seat was supported by a stanchion. Cloth upholstery with decorative stripes was used to finish the seats. Each car was also equipped with a safety belt mechanism adjacent to the seats nearest the articulation. The purpose of the safety belt was to secure wheelchairs, which enabled wheelchair bound individuals to ride the LRT cars safely. Each LRT car had a seating capacity of 64 passengers and could also accommodate 97 standees. (Duewag Specifications, 1978, p. 1, and Author's Photographs) The cab end of each car was fitted with a two-way radio set which was mounted to the right of the control console. The radio enabled the motorman to communicate with a dispatcher located at the Churchill Control Centre. (Author's Photographs; see also Chapter VI)

Each LRT car was finished in ET's standard colors. The cars were numbered 1001 through 1014. (See Appendix I) Most of the new cars were operational by the end of 1977 and were used for training purposes in early 1978. (Edmonton Journal, January 11, 1978, p. 1) When the LRT system was placed in regular operation in April 1978, two coupled LRT cars comprised each regular train, with three car trains being used during some peak periods. (Author's Photographs) Plate 48 (Author's Photograph) shows the appearance of LRT car Number 1004 coupled with another car during 1978. The following should be noted: A and B body sections, articulation, coupler, current collector, doors, headlights and tail lights, mirrors and the trucks.

Service Equipment, 1977

It had been decided by ET that a service vehicle was required to move any disabled LRT cars in the event of an accident or a power failure. A vehicle was required that was large, powerful and did not require electricity for its power. Edmonton Transit employed the Canron Railgroup Company of the United States to construct a unit suitable for this purpose. What Canron produced was a large four-wheeled dump truck-like vehicle that could travel along roads as well as on rails. The vehicle consisted of a welded steel frame which held a GMC model 453 diesel engine, an Allison four-wheel drive transmission, an operator's cab, and a small dump box. The frame also contained two sets of small

Plate 48. (Author's Photograph) LRT Passenger Car Number 1004

Plate 49. (Author's Photograph) Locomotive Number 2001
and Differential Dump Car

flanged steel wheels which were hydraulically raised and lowered. The flanged wheels permitted the unit to operate on the track, while the tires permitted the vehicle to travel along roads. To enable the unit to move LRT cars without damaging itself or the car, a Scharfenberg coupler was installed at the rear of the frame in addition to a spring loaded bumper bar above it. (Author's Photographs) The dump box enabled the vehicle to be used for small amounts of ballasting. The front of the frame was designed to hold snow removal apparatus such as curved blades; and such apparatus was applied to the unit in January 1979. (ETAR, 1979, p. 10)

The unit, which was called the "Kal-Trac heavy-duty land/rail vehicle", was painted a bright yellow and was numbered 3850. (Author's Photographs)

Passenger Equipment, 1979

By late 1978, ET was planning the extension of the LRT line from Belvedere Station to Clareview. (See Chapter VIII) In order to provide the same frequency of service along the entire line, three additional LRT cars were required. During this time, the City of Calgary had ordered a number of Duewag type RTE1 vehicles in order to provide service on its new LRT line in that city. In order to obtain the three required units quickly, Edmonton added its order for three cars onto Calgary's order in early 1979. The three additional LRT cars arrived in Edmonton during August. They were completed and painted in the Cromdale barns and were placed in service although the new Clareview extension was not complete. (ETAR, 1979, p. 11)

The three new cars were numbered 1015 through 1017 and contained some minor differences from cars 1001 through 1014. In addition to a warning horn, each of the new cars was equipped with an electric alarm gong at each end. Each gong was mounted below the floor of a cab and was activated by a switch. Unlike the streetcar gongs which were struck once each time the foot plunger was depressed, the alarm gongs were rung continuously as long as the switch was depressed. (Author's Photographs and Observations) It was believed that the unusual sound of the alarm gong would cause unwary pedestrians and motorists to notice the imminent approach of an LRT car.

The design of the openable portion of the large side windows was altered slightly. It should be recalled that the windows of the first 14 Edmonton LRT cars had the upper portion of the windows framed in extruded aluminum. This arrangement proved unsatisfactory since the framing could easily be distorted if the window was violently pulled open. The result of this treatment was drafts entering the car during cold weather. This problem was solved on the new cars by eliminating the aluminum framing and increasing the size of the rubber molding around the window. The frameless upper portion of each window, when closed, rested against the rubber molding which was flexible enough to seal the window and keep most drafts out of the interior. (Author's Observations)

The operation of the first 14 cars had revealed a problem that ET had not experienced since the time of the British Daimler-Duple motor buses some five years earlier. It should be recalled that one of the most serious drawbacks of the British buses was the scarcity of compatible domestic repair parts which were less expensive than imported parts. (See Chapter VI) The headlights supplied with the first 14 LRT cars, although sealed beam lamps, were larger in diameter than the standard North American sealed beam headlight. This condition meant that ET had to import replacement headlights from Europe at great cost. In order to eliminate this practice, ET specified that smaller headlight holes were to be cut into the fibreglass end panels on each car. This modification enabled ET to use the more common and less expensive North American sealed beam headlights. (Information from ET, and Author's Observations)

Equipment Modifications, 1979-1980

The original 14 LRT cars underwent several modifications during this period to make them safer and more efficient to operate. The previous section mentioned that these LRT cars were not able to use North American headlights because of their smaller diameter. In order to eliminate this condition, ET began to modify the headlight mounting holes on each of Numbers 1001 through 1014. As each car entered the shop for maintenance, the old headlights were removed and the existing holes were made smaller by the addition of fibreglass strips and polyester resin. After the fibreglass had hardened, it was smoothed and painted. The smaller North American headlights could then be installed. (Information from ET)

Each car was also equipped with electric alarm gongs to make them compatible with cars Numbers 1015 through 1017. (Author's Photographs) In order to alleviate some of the problems experienced with the aluminum-framed window sections, ET installed small brackets on the frames to the side of the windows. These brackets limited the amount that each window could be opened. This feature reduced the likelihood of the window frames being distorted which, in turn, would reduce the drafts entering the car. (Information from ET and Author's Observations)

It had been discovered that the windows in the partition separating the cab and the interior of the car had allowed too much light to enter the cab when the car was travelling in the tunnel sections or travelling at night. The light caused distracting reflections to appear on the inside of the windshield which interfered with the motorman's ability to see. To eliminate this problem, a dark tinted transparent tape was applied to the window. This tape enabled the passengers, in daylight, to see into the cab and out the windshield. When travelling in the dark, however, the tape served to reduce the amount of light entering the cab so that reflections were not produced on the inside of the windshield. (Author's Observations)

Freight and Service Equipment, 1980-1981

The start of the new underground extension of the LRT line beneath Jasper Avenue meant that some means of spoil (undesired excavated earth) removal had to be devised. It should be recalled from Chapter VIII that large ramps on side streets were constructed to enable dump trucks to be loaded with spoil from the excavation site. This arrangement, although satisfactory, caused an inconvenient disruption of normal traffic on that particular street and on streets in the immediate area. In order to keep the disruption of road traffic to a minimum, it was decided to remove the spoil by using special cars which would travel along the existing LRT line. In addition, the proposed site of the new LRT maintenance facility required large amounts of fill so disposal of the spoil would not be a problem. In order to transport the spoil along the LRT line, suitable cars were required as well as an electric locomotive to pull them. Edmonton Transit decided that it could purchase a used electric locomotive inexpensively and believed that it could design suitable freight cars for hauling the spoil. In 1979, ET was able to purchase a surplus electric locomotive from the British Columbia Hydro Rail

Company in Vancouver, B. C. (ETAR, 1979, p. 22)

The unit, which had been built in 1912 originally for the Oregon Electric Railway, had been used in Vancouver for freight operations between 1946 and 1970 when it was retired and placed in outdoor storage. (ETAR, p. 22, and Photographs in Author's Collection)

The locomotive had been manufactured by the American Locomotive Company (Alco) and consisted of a heavy riveted steel frame which supported a large cab in the centre and sloping steel cabinets on both ends of the cab. These cabinets, which sloped from the cab to the ends of the frame, housed some of the rheostats and some of the air brake apparatus as well as the sand bins. This type of locomotive was generally referred to as a "centre cab locomotive". The unit was equipped with two heavy-duty two axle Alco trucks which each held two outside hung General Electric motors. (Author's Observations)

The electrical equipment was supplied by the General Electric Company and functioned in a similar fashion to the series-parallel control found on the ERR streetcars of that era. The locomotive was also equipped with Westinghouse air brakes and a Westinghouse air compressor. In addition, the unit had the valves and piping necessary to operate the air brake apparatus on most pieces of railroad rolling stock. An air horn as well as a brass locomotive swing bell comprised the locomotive's warning devices. Current collection had been by means of trolley poles. (Author's Photographs)

The locomotive required extensive overhauling upon its arrival in Edmonton. In addition to being out of service for several years, some of the air brake parts protruded from the sides of the frame sufficiently to prevent the locomotive from clearing the station platforms. Also, the trolley pole current collector could not be used on the LRT catenary.

Upon its arrival in 1979, the locomotive was mechanically and cosmetically refurbished. Mechanical activities included: overhauling the electrical and the air brake apparatus, relocating the brake cylinder to enable the unit to clear the station platforms, installation of a half-pantograph current collector on the roof of the cab, and the installation of new headlights. In addition, an electrically powered hydraulic pump was installed on the locomotive. That unit was to be used to operate cylinders on the spoil cars. (Mainstream, November 1980, p. 7)

The locomotive was also repainted on the interior and the exterior after the surfaces had most vestiges of old paint removed. The exterior of the locomotive was painted in the standard ET colors. The locomotive was numbered 2001 and was placed in service during 1980. Plate 49 (Author's Photograph) shows the appearance of centre cab locomotive Number 2001 in July 1980. The roof mounted pantograph as well as the air horn and headlights should be noted.

The rolling stock pulled by the locomotive consisted of four flat cars and ten differential dump cars. (See Appendix I) All of this rolling stock was fabricated using the frames of surplus work equipment purchased from the Northern Alberta Railways (NAR; now part of CNR). (Mainstream, November 1980, p. 7) The first three units produced from the work equipment were flat cars. The flat cars consisted of the frame, trucks, couplers and air brake apparatus of the old work cars, with a wooden deck mounted on top of the frame. In addition, steel stake pockets were fabricated and were welded to the sides of the frames. The frames of the flat cars were painted an olive green which was similar to Pantone ink shade 574C. (Comparisons by Author with Pantone Matching System Book, 1980) The truck sideframes were also painted this shade of green. The three flat cars were numbered 2101 through 2103 and were used to transport various building and construction materials to the site of the underground extension. (Author's Photographs; see also Appendix I)

A special flat car with a depressed centre was fabricated from the frame of another work car by the Edmonton firm KML Custom Fabricators Limited. (Informaltion from Edmonton Transit) The construction of this flat car also required a quantity of new steel beams. The frame of this unit was welded together and was equipped with a wooden deck. This flat car was painted in a similar fashion to the regular flat cars and was numbered 2201. (Author's Photographs) Number 2201 was designed primarily to transport the mechanical excavator (the mole) to and from the construction site. The depressed centre on the flat car enabled the excavator to clear the ceiling of the tunnels. (Mainstream, Novlember 1980, p. 7)

The remaining rolling stock consisted of ten differential dump cars that were designed by ET and which used the frames and the trucks of surplus tank cars. The dump container for each car was fabricated by KML Custom Fabricators to ET's specifications. The rectangular dump containers were fabricated of sheet steel and hollow square steel sections which were welded together. Each dump container was fabricated so that it did not possess any internal dividers such as those found on the ERR's differential dump car. (See Chapter III) The capacity of each container was approximately 30 cubic yards (27 m^3). (Information from Edmonton Transit) The container was mounted on the frame of the car so that it was hinged longitudinally along the centre. The sides of the container were also hinged at the top and were normally kept closed by a system of levers. Hydraulic cylinders on both sides of the frame beneath the container permitted the container to be tipped to either side in order to facilitate unloading. Flexible hydraulic hoses with quick disconnect fittings enabled the hydraulic system of each dump car to be connected to the locomotive's hydraulic hoses. All but one of the dump cars was equipped with steel platforms at both ends. The platforms held the operating valves for the hydraulic cylinders as well as the hand brake wheels for each car. A short frame prevented one of the dump cars from being fitted with end platforms. The hydraulic control valves were located at the ends of the car near the couplers. (Author's Photographs; see also Appendix I)

The dump cars were painted in the olive green paint scheme and were numbered 2301 through 2310. (Author's Photographs) Most of the freight equipment was completed during 1980. (See Appendix I) When complete, each dump car was placed in service hauling spoil from beneath Jasper Avenue to the site of the new LRT maintenance facility. Plate 49 (Author's Photograph) depicts one of the differential dump cars coupled behind the locomotive during July 1980.

Passenger Equipment, 1981-1983

The construction of the Jasper Avenue extension as well as the prospect of the construction of further extensions prompted ET to order 20 additional LRT cars from Duewag/Siemens. (ETAR, 1982, p. 23) These cars were identical in external appearance to the 17 type RTE1 cars in service in Edmonton. The 20 new cars contained some mechanical improvements, however. The number of heating elements for the cabs and the interior of the cars was increased so that the cars would be sufficiently warm in the coldest Edmonton weather. A more comfortable seat was installed in each cab. In addition, the door to each cab was changed from a swing door to a sliding door. (ETAR, p. 23) The swing door was dispensed with because that type of door, which was installed on Numbers 1001 through 1017, occasionally struck a departing passenger when the motorman was attempting to leave the cab after the car arrived at a terminal and many passengers were attempting to leave the car. (Author's Observations) Other improvements included: metal scuff panels to protect the hot air ducts from foot damage, ceiling-mounted radio sets in the cabs, and a manual release mechanism for the disc brake calipers that could be operated from inside the car. This feature was particularly useful if one or more brake calipers became stuck. In the past, if a caliper could not be reset, the caliper could be reset manually only from underneath the car. This was a difficult, time consuming and dangerous maneuver. The new manual release mechanism reduced the safety hazard of releasing stuck brake calipers and shortened the time necessary to complete the task.

Three of the new cars arrived in late 1982, with the remainder arriving during 1983. (See Appendix I) Final assembly and painting of the cars was done at the Cromdale barns. (ETAR, 1982, p. 23) The cars were painted in the same manner as the LRT cars in service and were numbered 1018 through 1037. (Author's Photographs; see also Appendix I)

Further extensions of the LRT system will require the purchase of additional passenger cars. Whether the Duewag/Siemens built RTE1 vehicles will continue to be acquired will depend upon cost, availability, and the suitability of domestic-built LRT vehicles.

Chapter X

Conclusions, Observations and Recommendations

Conclusions and Observations

This report has outlined and described the various transportation technologies that have been implemented in Edmonton for public use, the reasons for their initial use, and a description and reasons for the changes from one type of technology to another. The report covered this development from the beginnings of the Edmonton Radial Railway through the early 1980's. To the author's knowledge, no similar technological history has been done in the past at any Canadian university.

The design of this report and the implemented research methods were primarily intended to produce a chronicle of the historical technical developments of the municipally-owned public transportation system in Edmonton. The flexibility and the logical design of this report was intended to make it a viable method to use in other subject areas.

The importance of prevalent and changing socio-economic conditions upon the technological development of the transit system has been described. The effects of wars, economic recessions and the rise of the automobile have all had profound effects upon the development of transportation technology. The transportation of freight by the ERR, for example, was an essential and a desired service by large companies before the widespread use of large motor trucks and all-weather streets that could support them. Before the popularity of motor trucks, the ERR purchased and constructed special tracks and rolling stock that were specifically designed for freight transportation purposes. The increasing numbers of paved streets and the arrival of large motor trucks that could reach customers without the need of tracks eventually eliminated the freight business of the ERR. Trucks proved to be more economical to operate than the street railway mainly because of their flexibility. The rise of the automobile also made some pieces of service rolling stock obsolete. Sprinkler cars, which had been used to flush horse manure to the sides of paved streets with streetcar tracks, were not required after the demise of the horse as the prevalent means of personal or commercial transportation. Automobiles also made the placement of the street railway tracks in the centre of the street obsolete. The tracks were usually placed in the centre of the street to assist with track drainage, since the surface of most streets was crowned. In order for individuals to leave or to reach the streetcars, they had to cross at least one lane of traffic. This maneuver was hazardous and tended to disrupt the flow of automobile traffic. Motor and trolley buses could load and unload passengers at the sides of the roads, which was safer and more convenient for the passengers.

The crowding of existing streets by traffic was a major factor in the decision to construct a rapid transit system. By employing techniques of underground construction and the isolation of surface grades from street traffic wherever possible, Edmonton was able to upgrade its transportation system in part so that it could move large numbers of people great distances quickly, without hindrance from traffic.

From the beginnings of a municipally-owned public transportation system in Edmonton, the main criterion for selecting particular technologies has been cost. While some may believe this criterion to be beneficial to the taxpayer since capital costs were kept low, in the long term both the taxpayer and the transportation system have suffered because of high yearly maintenance costs that have frequently resulted in higher costs than more expensive types of construction and equipment. In the first months of track construction on the ERR in 1907 and 1908, heavy rails were securely installed on a substantial concrete roadbed. The extreme cost of this construction method combined with a paucity of funds led the city to replace that construction method with one which used lighter rail and a so-called "temporary" roadbed. Although temporary track was much cheaper to construct than permanent track, the temporary track required constant maintenance and repair and was usually rougher riding. These factors contributed to poor service, rapid wear of equipment, and high maintenance costs. In the short term, temporary track was cheaper than permanent track but over a protracted period, temporary track was more expensive and, therefore, was poor economy.

Cost and immediate availability have been the main criteria for the selection of rolling stock throughout the history of the transportation system in Edmonton. These criteria have been shown to be unsatisfactory since many items of rolling stock have been obtained in this manner which were not well suited to Edmonton's climate and, therefore, have required expensive modifications to make them serviceable. The St. Louis streetcars, for example, were purchased because they could be delivered within a short time. Those streetcars were found to be too cold during winter no matter what modifications were made to them. Although they were obtained quickly, their inadequacies were experienced for many years. Against the recommendation of the consulting engineers Wilson and Bunnell, the Street Railway Department purchased British trolley buses that were less expensive than American built units. The British trolley buses proved to be difficult to operate and to maintain in Edmonton. Although modifications were made to these buses, their life span was much shorter than subsequent trolley buses that were purchased from American builders. By not following the recommendations of consultants who had experience with trolley bus operation, unsuitable equipment was obtained.

The same experience was repeated during the 1960's with the purchase of the Japanese buses and the British Daimler-Duple buses. These buses, although cheaper than domestic buses, had not operated in such harsh climates and were found to be unsuitable. The foreign vehicles were so unreliable that used domestic equipment that the City had purchased for use during peak hours were found to operate more satisfactorily. Although most of the problems were corrected with the foreign buses, revenue was lost for the time they were out of service.

The German LRT cars, which were selected primarily because of availability, are somewhat expensive to maintain because some of their replacement parts are not readily available in Canada.

It has been shown in the report that changes and modifications to existing technology have frequently come about because of inadequacies of the equipment purchased and because of new technological developments. It should be noted that the electric heaters supplied with the first streetcars were frequently found to be unsatisfactory in providing sufficient heat in extremely cold weather. When the technology of forced air heaters was developed and such units were made available, the ERR replaced the electric heaters with the more effective hot air units. As well, windshield wipers had not been invented when the first streetcars were purchased by the City of Edmonton. When they were developed and began to appear on other vehicles, attempts were made at installing them on the streetcars.

Most changes from obsolete technology to more efficient types came about only if the capital cost was not excessive. Most of the wooden passenger streetcar bodies were overhauled and kept in good repair because wood and the necessary wood working tools were inexpensive and repairs to such vehicles were usually a simple series of operations. The electrical apparatus, which was costly, was not changed on most of the streetcars although the K-6 controller was obsolete by 1930 and was known not to be as efficient or safe as the K-35 controller that had been supplied with the five new Ottawa Car Manufacturing Company streetcars delivered in 1930. By not upgrading the electrical apparatus or by not replacing the older streetcars with newer and more efficient designs, the Street Railway Department ensured the demise of the street railway. The lack of permanent track combined with obsolete and inefficient rolling stock meant that large capital expenditures were required if the street railway was to be retained. Motor and trolley buses were seen to be less costly and more flexible than streetcars. It is for that reason that the street railway system was phased out. Other cities, such as Toronto, chose to maintain its trackage and to replace obsolete rolling stock with newer equipment. By making frequent changes, Toronto still operates a viable street railway system.

A similar observation can be seen in the equipment used for the electrical power generation for the street railway. The system of reciprocating steam engines which were used to rotate generators was used by the ERR since its beginning. By the late 1920's, this type of power generation was considered inefficient and obsolete. The acquisition of more efficient mercury arc rectifiers came about not because the City realized that they were more efficient than engine driven generators. The rectifiers were purchased because one of the steam engines became irreparably damaged and a replacement would have cost more than a mercury arc rectifier. In this instance, the cost factor contributed to the improvement of the existing technology. A similar development enabled the mercury arc rectifiers to be gradually replaced with solid state units which were more efficient. It should be noted that the longevity of most power generation equipment is a contributing point in favor of the retention of electrically-powered vehicles.

Ultimately, cost has been the deciding factor which has determined the type of fuel used by motor buses. It should be noted that the first motor buses had their gasoline engines replaced by diesel engines at an early stage even though diesel engines had rarely been used. This was done because it was discovered that diesel fuel was much cheaper than gasoline and by using diesel fuel in its buses, the Street Railway Department could save money. It is for this reason that subsequent motor buses were purchased which were equipped with diesel engines. Diesel fuel, however, became an essential commodity during the Second World War and supplies of it became scarce. This development forced the Street Railway Department to obtain motor buses equipped with gasoline engines. At the earliest opportunity, the transit system attempted to use a different fuel that was less expensive, hence the development of propane powered engines. By 1960, diesel fuel had become readily available again and most bus manufacturers discontinued the production of propane units. Lack of availability forced the transit system to readopt the use of diesel buses. In these instances, the transit system had little control over the type of fuel used since it did not have the resources or the technology to construct engines. The various uses of motor fuel, therefore, have been a result of changes in the bus manufacturing industry which responded to prevalent political and economic conditions.

In spite of the many changes in the types of rolling stock, it is apparent from the findings in this report that electrically powered vehicles have had a much longer useful life than motor buses. Many streetcars, for example, remained in service over 40 years and at the end of street railway service, much of the electrical apparatus was still serviceable, although obsolete. Most trolley buses have lasted longer than most motor buses. The electrical apparatus, in fact, has outlived some trolley bus bodies and has been reused in some newer trolley buses.

The electrical generation and distribution equipment, although increasing the capital cost of trolley buses, has proven to be extremely long lived. It should be noted that the earliest mercury arc rectifier had been in service for 50 years before it was considered to be uneconomical to repair and keep in service. Most motor buses because of their many moving parts require expensive and frequent maintenance and usually do not last as long as trolley buses. Frequent economic studies have occasionally shown trolley buses not to be as economical to operate as motor buses. Given the longevity of trolley buses and the required ancillary equipment; and given the volatile nature of fuel prices, it seems foolish that the City would entertain the idea of replacing trolley buses with motor buses. In addition, although the wires required for trolley buses can be considered visual pollution, trolley buses do not produce noxious air pollutants whereas motor buses do. Motor buses, as well, are no more esthetically pleasing than trolley buses or any other type of public transportation vehicle.

Despite a preoccupation with cost, the transit system has also made safety and rider comfort high priorities. The first streetcars which had single fixed steps on both sides were found to be unsafe when some individuals sustained injuries while trying to board a streetcar from the wrong side. This situation led to the ERR adopting a sliding step on newer equipment in order to reduce the likelihood of individuals attempting to board a streetcar from the wrong side. In response to many complaints about the height of the various types of single steps, the ERR designed a double step with a folding bottom tread. This design increased the number of step treads while maintaining a safety feature. Air brakes were installed on most passenger streetcars well ahead of federal legislation requiring air brakes because many citizens had expressed concern that the hand brakes used on the streetcars could be inadequate on some of the steep grades found on the ERR. Although the cost of the air brake equipment was high, the ERR endeavoured to improve the safety of its streetcars in order to satisfy the wishes of its customers. The use of forced air heaters on the streetcars, while not improving the operation of the streetcars, did make the streetcars more comfortable for both the passengers and the motormen. The installation of right-hand rear view mirrors on the streetcars also improved safety since the mirror enabled a motorman to see any pedestrians or vehicles that could get pinned between the streetcar and the curb when the streetcar made a right turn.

Occasionally, the installation of safety equipment or modifications to safety equipment came about because a safety hazard was not realized. Such oversights usually resulted in injuries or the loss of life. These incidents usually resulted in law suits which cost the City more than the cost of installing the required equipment in the first instance. One such example occurred with the single end streetcars. Originally, no warning or safety devices were placed at the rear of such streetcars. If someone happened to be in the way of a backing streetcar and they were unaware of its approach, they could be seriously injured or killed. Although people were not supposed to be located behind a backing streetcar, they occasionally were. In 1912, for instance, a young child playing on the Y at 95th Street and 118th Avenue was killed by a backing streetcar because he did not realize the streetcar was approaching, nor did the streetcar conductor realize that the child was there until the streetcar was too close to stop. The lack of a warning device prevented the conductor from being able to sound any warning. The lack of any safety features resulted in the child being crushed by the rear truck. After unpleasant publicity and a stiff lawsuit, gongs were installed on the rear platforms of all single end streetcars. In addition, it should be noted that all new single end streetcars that were purchased subsequently were equipped with some form of warning device at the rear. In the case of the big Preston streetcars purchased in 1913, motor and brake controls were also installed in the rear vestibule.

In spite of such occurrences in the past, the present management of the transit system appears to be unaware of most of the past problems and developments of transportation technology. Examples of this can be found in the present LRT system. The system was designed so that the LRT cars did not travel along any streets shared by pedestrians and vehicles. The LRT cars, however, cross some streets at grade and, therefore, present a danger to motorists and pedestrians. Crossing barriers and warning signs are supposed to keep pedestrians and motorists away from crossings when the LRT cars approach and occupy the crossings. The potential for mishaps prevails. It was noted that the lifeguard provided with each Duewag LRT truck was considered equivalent to the lifeguard supplied with the Brill 21-E streetcar truck of 1908. That safety device was found to be inadequate at that time and was improved by the installation of a lifeguard that physically surrounded a prone individual. It is disturbing, therefore, to note that adequate lifeguards have not been installed on the LRT vehicles. Although LRT vehicles are not streetcars and people should not get in their way, the prospect exists that a serious mishap can occur. One such example could be a child or a senior citizen falling across a track at a crossing immediately before arrival of an LRT vehicle. Given the reaction time of the equipment and the motorman, it is possible that the individual would be crushed by the lead truck of the LRT car. An equally tragic mishap could occur if a person should inadvertently fall from a platform onto the track in front of an approaching LRT car. The lifeguards supplied with the LRT cars, like the lifeguards supplied with the Brill 21-E truck, have the potential to enable a prone individual to be crushed by the truck. The use of a lifeguard similar to the Hudson-Bowring type used on Edmonton's streetcars after 1912 would improve the safety of the LRT cars and could prevent the needless loss of life.

The selection of suitable warning devices has also been a problem with the LRT cars. The supplied warning horns tend to resemble automobile horns and are not readily associated with large vehicles. The addition of alarm gongs has not improved the effectiveness of the warning devices. Although gongs were used on streetcars, such vehicles have not appeared in Edmonton since 1951 and there are many citizens who have never heard or seen a streetcar. Upon hearing a gong, such people are likely to be confused rather than warned of the imminent approach of a large vehicle. Two possible solutions to this problem could be implemented. A public awareness campaign could be undertaken to educate the public as to the meaning of the alarm gongs. If this action is unfeasible, a warning device associated with the trains, such as an air horn or whistle, could be installed using self-contained air-operated devices. It is essential, in any case, that the public not confuse an LRT warning device with a warning device found on some other type of vehicle.

This observation has raised another point: the reluctance of some public employees to assist researchers because their findings might be seen as damaging to their department's image. It should be realized by all civic employees that they work for a publicly owned corporation which, by its nature, must be open to public scrutiny and input. There is a bylaw at the municipal level, as well as similar laws at the provincial and federal levels, which guarantees each citizen the right to peruse and inspect the information contained in public bodies. To be sure, most public employees, City departments as well as private companies and individuals, were extremely generous and helpful to the author and made the job of research gathering an extremely accurate and pleasant task. (See also Appendix II) Some public employees, however, felt that it was not required that they be of assistance since they were not interested in such public relations or because they did not see any merit to this kind of historical research.

This attitude is disturbing not only because it shows a lack of understanding and a disdain for truthful and scholarly research, but also because it shows a lack of respect for the individual citizens who are taxpayers and, therefore, are entitled to common courtesy.

Recommendations

This report, which has chronicled the history and the development of public transportation in Edmonton, has results that can be used by educators, historians, researchers and museums. The format and the content of this report have been designed to facilitate the use of them by industrial arts (practical arts), vocational education, and social studies teachers and curriculum planners for secondary education. Chapter I noted that most industrial arts (practical arts) and vocational education programs lack content that describes the development of specific technologies and their relevance and practical applications in the past as well as their impact upon present society. This report has shown examples of where wood, plastic, metal, electricity, power, drafting and electronics technologies have all been essential parts of the development of public transportation technology in Edmonton. The report has also shown that, for various reasons, the application and the prevalence of some forms of technology have become obsolete, while other technologies have either remained applicable or new technologies have been devised to satisfy a specific need. If nothing else, the inclusion of such historical information in an industrial arts (practical arts) curriculum will provide the student with an understanding of why technology is constantly changing and why certain technologies are being taught while others are not.

It is recommended that this report be used as resource material by educators to enable them to obtain useful and interesting background information on the development of certain technologies and to enable them to prepare accurate and useful units of study. The chronological format of the report lends itself to easy selection of material from all periods covered in the report. The use of tables, illustrative material and rosters provides the reader with tangible means of comparison between types of vehicles as well as between construction and maintenance methods. The inclusion of Appendix I, which contains a summary of all rolling stock used by the transit system within the time boundaries of this report, enables the reader to discern easily the important features of each vehicle. In addition, the Appendix also enables quick comparisons between types and makes of vehicles, as well as the various changes made to the vehicles. These features increase the usefulness of the report since they present concise summaries of significant points. Because the technological development of the transit system has been closely aligned with socio-economic conditions, the reader can also obtain an understanding of the conditions prevalent during each period covered.

The chronological and the practical nature of the report should enable civil employees to obtain adequate knowledge of previous developments and problems in the transit system. Some of this knowledge should be applied to the current technologies in order to make them safer and more efficient. It is also possible that some obsolete technologies described in the report, such as the movement of freight by the street railway, may provide civil employees with ideas for similar technologies that could be implemented. The report, therefore, could be used to increase the revenues of the transit system.

Since the development of public transportation in Edmonton usually reflected developments within the transportation industry, the research methods, findings and the format of this report should be applied to other technological studies in aspects of transportation. The logical design of the report, however, should enable researchers to apply the design to other aspects of technological development which are not related to transportation.

The detailed description of the technical aspects of the various vehicles and systems should enable individuals engaged in restoration to be able to restore or to reconstruct vehicles that accurately reflect the materials and the technologies of the various periods. The explanation of the various safety devices, as well, should also enable restorers to ensure that operational preserved vehicles do not pose serious safety hazards to the public.

The need for further studies in aspects of historical technology is great. Without a proper understanding of past technologies and the problems encountered with them, many difficulties and problems experienced in the past may be encountered in the future.

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Appendix I

This Appendix, which is divided into three main categories, contains a listing of all passenger, freight and service rolling stock and vehicles used by the municipally-owned public transportation system in Edmonton since its beginning in 1908. The listing includes all vehicles up to and including the early 1980's. In addition to the vehicle identification, general dimensions and weight are included where they are available. No weights are listed for streetcars and other railed vehicles, since accurate weights were not always available. In addition, many changes and modifications to the various types of railed vehicles drastically altered their weights, so the inclusion of a single weight for each vehicle would have been misleading.

Information relevant to the type of motive power of each vehicle is included as well as significant dates in the life of the vehicle. Each vehicle is listed chronologically, not by number, but by its date of arrival in the City of Edmonton. Some units appear in the listing several times because they were assigned different numbers or designations throughout their lives. In such cases, cross-referencing comments are provided in order to prevent reader confusion. Leased vehicles as well as units purchased from other properties for parts only are listed.

By including this Appendix, and by arranging it in this chronological fashion, the reader should be able to more easily follow the chronological descriptions of rolling stock in the text. In addition, the reader can also obtain an overall impression about the types or makes of rolling stock and vehicles by perusing this Appendix.

Index of Abbreviations for Appendix I

AC	Allis Chalmers
ACF	American Car and Foundry
AEC	Associated Equipment Company
ALCO	American Locomotive Company
B.C.	British Columbia
BBC	Brown Boveri Company
B Boveri	Brown Boveri Company
CCF	Canadian Car and Foundry
CGE	Canadian General Electric
DE	Double End
Duewag	Waggonfabrik Uerdingen
EE	English Electric
ERR	Edmonton Radial Railway
ET	Edmonton Transit
ETS	Edmonton Transit or Transportation System
FE-CE	Front Entrance - Centre Exit
FIL	Flyer Industries Limited
FTC	Fageol Twin Coach
GE	General Electric (United States)
GEC	General Electric Company (British)
GMC	General Motors Coach
h	Hour
H.P.	Horse Power
kg	Kilogram
km	Kilometre
kN	Kilonewton

kPa	Kilopascal
kW	Kilowatt
Lbs.	Pounds
LRT	Light Rail Transit
m	Metre
McG-C	McGuire-Cummings
MCB	Master Car Builders
mm	Millimetre
MRC	Magnetic Remote Control
MU	Multiple Unit Operation
N/A	Not Applicable
NAR	Northern Alberta Railways
N.B.	New Brunswick
OCC	Ottawa Car Company
OCM	Ottawa Car Manufacturing Company
PAYE	Pay As You Enter
PC&C	Preston Car and Coach Company
SE	Single End
TDH	Transit Diesel Hydraulic
TTC	Toronto Transit or Transportation Commission
T&YRR	Toronto and York Radial Railway
U.L.	Underwriters' Laboratory
WFC	Western Flyer Company
WH	Westinghouse

This section of the Appendix contains a chronological listing of all passenger, freight, and service streetcars obtained and operated between 1908 and 1951. This section also includes a listing of all passenger, freight, and service LRT vehicles obtained between 1978 and 1982.

The information includes: the vehicle number, delivery condition, date ordered, delivery date, major dimensions, seating capacity, type of trucks, make and type of motors, withdrawl date, disposal date, and any remarks cogent to the vehicle.

CAR NUMBER: 2 SEATING: 40
DELIVERY CONDITION: ELECTRICS NOT INSTALLED
MFR/MODEL: OCC, DE

LENGTH: 38'6.5"(11 748 mm) MOTORS: 4, GE-80A-1
WIDTH: 8'6"(2 591 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: BRILL 27-GE-1
ROOF TYPE: MONITOR, STRAIGHT ENDS

ORDERED: 8/1908 WITHDRAWN: 11/1918
DELIVERY: 10/26, 1908 DISPOSAL: FRAME FOR SWEEPER 3
REMARKS: WRECKED BY TRAIN

CAR NUMBER: 1 SEATING: 40
DELIVERY CONDITION: ELECTRICS NOT INSTALLED
MFR/MODEL: OCC, DE

LENGTH: 38'6.5"(11 748 mm) MOTORS: 4, GE-80A-1
WIDTH: 8'6"(2 591 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: BRILL 27-GE-1
ROOF TYPE: MONITOR, STRAIGHT ENDS

ORDERED: 8/1908 WITHDRAWN: 9/1, 1951
DELIVERY: 10/31, 1908 DISPOSAL: N/A
REMARKS: REBUILT SE IN 1929, NOW AT FORT EDMONTON PARK

CAR NUMBER: 3 SEATING: 40
DELIVERY CONDITION: ELECTRICS NOT INSTALLED
MFR/MODEL: OCC, DE

LENGTH: 38'6.5"(11 748 mm) MOTORS: 4, GE-80A-1
WIDTH: 8'6"(2 591 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: BRILL 27-GE-1
ROOF TYPE: MONITOR, STRAIGHT ENDS

ORDERED: 8/1908 WITHDRAWN: 1927; 1947
DELIVERY: 11/7, 1908 DISPOSAL: 6/1948
REMARKS: REUSED & REBUILT, SE IN 1929

CAR NUMBER: 4 SEATING: 40
DELIVERY CONDITION: ELECTRICS NOT INSTALLED
MFR/MODEL: OCC, DE

LENGTH: 38'6.5"(11 748 mm) MOTORS: 4, GE-80A-1
WIDTH: 8'6"(2 591 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: BRILL 27-GE-1
ROOF TYPE: MONITOR, STRAIGHT ENDS

ORDERED: 8/1908 WITHDRAWN: 1947
DELIVERY: 11/9, 1908 DISPOSAL: 1948
REMARKS: REBUILT SE IN 1912

CAR NUMBER: 5 SEATING: 40
DELIVERY CONDITION: ELECTRICS NOT INSTALLED
MFR/MODEL: OCC, DE

LENGTH: 38'6.5"(11 748 mm) MOTORS: 4, GE-80A-1
WIDTH: 8'6"(2 591 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: BRILL 27-GE-1
ROOF TYPE: MONITOR, STRAIGHT ENDS

ORDERED: 8/1908 WITHDRAWN: 1947
DELIVERY: 11/18, 1908 DISPOSAL: 1948
REMARKS: REBUILT SE IN 1912

CAR NUMBER: 6
SEATING: 40
DELIVERY CONDITION: ELECTRICS NOT INSTALLED
MFR/MODEL: OCC, DE

LENGTH: 38'6.5"(11 748 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 12'(3 658 mm)
ROOF TYPE: MONITOR, STRAIGHT ENDS
MOTORS: 4, GE-80A-1
HORSEPOWER: 40(29.8 kW)
TRUCKS: BRILL 27-GE-1

ORDERED: 8/1908
DELIVERY: 11/22, 1908
REMARKS: REBUILT SE IN 1912
WITHDRAWN: 1947
DISPOSAL: 1948

CAR NUMBER: 7
SEATING: 32
DELIVERY CONDITION: ELECTRICS NOT INSTALLED
MFR/MODEL: OCC, DE

LENGTH: 31'10"(9 703 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 12'(3 658 mm)
ROOF TYPE: MONITOR, STRAIGHT ENDS
MOTORS: 2, GE-80A-1
HORSEPOWER: 40(29.8 kW)
TRUCKS: BRILL 21-E

ORDERED: 8/1908
DELIVERY: 12/14, 1908
REMARKS: REUSED AS PASSENGER CAR
WITHDRAWN: BEFORE 10/1911, 12/1927
DISPOSAL: 1928

CAR NUMBER: 10
SEATING: 40
DELIVERY CONDITION: AIR BRAKES NOT INSTALLED
MFR/MODEL: PC&C, DE, PAYE

LENGTH: 42'(12 802 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 12'(3 658 mm)
ROOF TYPE: MONITOR, BULLNOSE ENDS
MOTORS: 4, GE-80A-1
HORSEPOWER: 40(29.8 kW)
TRUCKS: BEMIS 45

ORDERED: 12/1908
DELIVERY: 6/1909
REMARKS: USED FOR PARTS
WITHDRAWN: 1938
DISPOSAL: 1947

CAR NUMBER: 12 SEATING: 40
DELIVERY CONDITION: AIR BRAKES NOT INSTALLED
MFR/MODEL: PC&C, DE, PAYE

LENGTH: 42'(12 802 mm) MOTORS: 4, GE-80A-1
WIDTH: 8'6"(2 591 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: BEMIS 45
ROOF TYPE: MONITOR, BULLNOSE ENDS

ORDERED: 12/1908 WITHDRAWN: 1948
DELIVERY: 6/1909 DISPOSAL: 1948
REMARKS: SE IN 1919; AGAIN SE IN 1929

CAR NUMBER: 14 SEATING: 40
DELIVERY CONDITION: AIR BRAKES NOT INSTALLED
MFR/MODEL: PC&C, DE, PAYE

LENGTH: 42'(12 802 mm) MOTORS: 4, GE-80A-1
WIDTH: 8'6"(2 591 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: BEMIS 45
ROOF TYPE: MONITOR, BULLNOSE ENDS

ORDERED: 12/1908 WITHDRAWN: 5/1938
DELIVERY: 7/1909 DISPOSAL: 1941
REMARKS: SE IN 1914; LIBRARY CAR, 1941

CAR NUMBER: 16 SEATING: 40
DELIVERY CONDITION: AIR BRAKES NOT INSTALLED
MFR/MODEL: PC&C, DE, PAYE

LENGTH: 42'(12 802 mm) MOTORS: 4, GE-80A-1
WIDTH: 8'6"(2 591 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: BEMIS 45
ROOF TYPE: MONITOR, BULLNOSE ENDS

ORDERED: 12/1908 WITHDRAWN: 1948
DELIVERY: 7/1909 DISPOSAL: 1948
REMARKS: SE IN 1917; RETIRED 1938; REUSED 1943

CAR NUMBER: 15
SEATING: 32
DELIVERY CONDITION: ELECTRICS AND AIR BRAKES NOT INSTALLED
MFR/MODEL: OCC, DE, PAYE

LENGTH: 42'(12 802 mm)
MOTORS: 4, GE-80A-1
WIDTH: 8'6"(2 591 mm)
HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm)
TRUCKS: BRILL 27-GE-1
ROOF TYPE: MONITOR, BULLNOSE ENDS

ORDERED: 11/1909
WITHDRAWN: 1950
DELIVERY: 7/1910
DISPOSAL: 1951
REMARKS: REBUILT, SE WITHOUT TRUSS-RODS, 1917

CAR NUMBER: 17
SEATING: 32
DELIVERY CONDITION: ELECTRICS AND AIR BRAKES NOT INSTALLED
MFR/MODEL: OCC, DE, PAYE

LENGTH: 42'(12 802 mm)
MOTORS: 4, GE-80A-1
WIDTH: 8'6"(2 591 mm)
HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm)
TRUCKS: BRILL 27-GE-1
ROOF TYPE: MONITOR, BULLNOSE ENDS

ORDERED: 11/1909
WITHDRAWN: 9/1949
DELIVERY: 7/1910
DISPOSAL: 2/1950
REMARKS: REBUILT WITHOUT TRUSS-RODS

CAR NUMBER: 18
SEATING: 32
DELIVERY CONDITION: ELECTRICS AND AIR BRAKES NOT INSTALLED
MFR/MODEL: OCC, DE, PAYE

LENGTH: 42'(12 802 mm)
MOTORS: 4, GE-80A-1
WIDTH: 8'6"(2 591 mm)
HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm)
TRUCKS: BRILL 27-GE-1
ROOF TYPE: MONITOR, BULLNOSE ENDS

ORDERED: 11/1909
WITHDRAWN: 3/1948
DELIVERY: 8/1910
DISPOSAL: 6/1948
REMARKS:

CAR NUMBER: 19 SEATING: 32
DELIVERY CONDITION: ELECTRICS AND AIR BRAKES NOT INSTALLED
MFR/MODEL: OCC, DE, PAYE

LENGTH: 42'(12 802 mm) MOTORS: 4, GE-80A-1
WIDTH: 8'6"(2 591 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: BRILL 27-GE-1
ROOF TYPE: MONITOR, BULLNOSE ENDS

ORDERED: 11/1909 WITHDRAWN: 1948
DELIVERY: 8/1910 DISPOSAL: 1948
REMARKS: REBUILT WITHOUT TRUSS-RODS

CAR NUMBER: 20 SEATING: 32
DELIVERY CONDITION: ELECTRICS AND AIR BRAKES NOT INSTALLED
MFR/MODEL: OCC, DE, PAYE

LENGTH: 42'(12 802 mm) MOTORS: 4, GE-80A-1
WIDTH: 8'6"(2 591 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: BRILL 27-GE-1
ROOF TYPE: MONITOR, BULLNOSE ENDS

ORDERED: 11/1909 WITHDRAWN: 1948
DELIVERY: 11/1910 DISPOSAL: 1948
REMARKS:

CAR NUMBER: 21 SEATING: 32
DELIVERY CONDITION: ELECTRICS AND AIR BRAKES NOT INSTALLED
MFR/MODEL: OCC, DE, PAYE

LENGTH: 42'(12 802 mm) MOTORS: 4, GE-80A-1
WIDTH: 8'6"(2 591 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: BRILL 27-GE-1
ROOF TYPE: MONITOR, BULLNOSE ENDS

ORDERED: 11/1909 WITHDRAWN: 10/22, 1919
DELIVERY: 11/1910 DISPOSAL: 10/1919
REMARKS: SEVERE MISHAP, DESTROYED

CAR NUMBER: 8,9,11,13,22,23 SEATING: 32
DELIVERY CONDITION: N/A
MFR/MODEL: OCC, DE, PAYE

LENGTH: 42'(12 802 mm) MOTORS: 4, GE-80A-1
WIDTH: 8'6"(2 591 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: N/A
ROOF TYPE: MONITOR, BULLNOSE ENDS

ORDERED: 4/1910 WITHDRAWN: N/A
DELIVERY: N/A DISPOSAL: N/A
REMARKS: ORDER RE-NEGOTIATED 10/1910; SEE BELOW

CAR NUMBER: 8 SEATING: 37
DELIVERY CONDITION: READY TO RUN
MFR/MODEL: OCC, SE, PAYE

LENGTH: 42'(12 802 mm) MOTORS: 4, WH-101-B-2
WIDTH: 8'8"(2 642 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: BRILL 27-GE-1
ROOF TYPE: MONITOR, BULLNOSE ENDS

ORDERED: 10/1910 WITHDRAWN: 1948
DELIVERY: 4/1911 DISPOSAL: 1948
REMARKS: REBUILT WITHOUT TRUSS RODS

CAR NUMBER: 9 SEATING: 37
DELIVERY CONDITION: READY TO RUN
MFR/MODEL: OCC, SE, PAYE

LENGTH: 42'(12 802 mm) MOTORS: 4, WH-101-B-2
WIDTH: 8'8"(2 642 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: BRILL 27-GE-1
ROOF TYPE: MONITOR, BULLNOSE ENDS

ORDERED: 10/1910 WITHDRAWN: 1948
DELIVERY: 4/1911 DISPOSAL: 1948
REMARKS: REBUILT WITHOUT TRUSS RODS

CAR NUMBER: 11 SEATING: 37
DELIVERY CONDITION: READY TO RUN
MFR/MODEL: OCC, SE, PAYE

LENGTH: 42'(12 802 mm) MOTORS: 4, WH-101-B-2
WIDTH: 8'8"(2 642 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: BRILL 27-GE-1
ROOF TYPE: MONITOR, BULLNOSE ENDS

ORDERED: 10/1910 WITHDRAWN: 1948
DELIVERY: 4/1911 DISPOSAL: 1948
REMARKS: REBUILT WITHOUT TRUSS RODS

CAR NUMBER: 13 SEATING: 37
DELIVERY CONDITION: READY TO RUN
MFR/MODEL: OCC, SE, PAYE

LENGTH: 42'(12 802 mm) MOTORS: 4, WH-101-B-2
WIDTH: 8'8"(2 642 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: BRILL 27-GE-1
ROOF TYPE: MONITOR, BULLNOSE ENDS

ORDERED: 10/1910 WITHDRAWN: 1948
DELIVERY: 4/1911 DISPOSAL: 1948
REMARKS: REBUILT WITHOUT TRUSS-RODS;
NOW AT FORT EDMONTON PARK

CAR NUMBER: 22 SEATING: 37
DELIVERY CONDITION: READY TO RUN
MFR/MODEL: OCC, SE, PAYE

LENGTH: 42'(12 802 mm) MOTORS: 4, WH-101-B-2
WIDTH: 8'8"(2 642 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: BRILL 27-GE-1
ROOF TYPE: MONITOR, BULLNOSE ENDS

ORDERED: 10/1910 WITHDRAWN: 6/1917
DELIVERY: 6/1911 DISPOSAL: 1919
REMARKS: FIRE; PARTS USED FOR OBSERVATION CAR

CAR NUMBER: 23
SEATING: 37
DELIVERY CONDITION: READY TO RUN
MFR/MODEL: OCC, SE, PAYE

LENGTH: 42'(12 802 mm)
WIDTH: 8'8"(2 642 mm)
HEIGHT: 12'(3 658 mm)
MOTORS: 4, WH-101-B-2
HORSEPOWER: 40(29.8 kW)
TRUCKS: BRILL 27-GE-1
ROOF TYPE: MONITOR, BULLNOSE ENDS

ORDERED: 10/1910
DELIVERY: 6/1911
WITHDRAWN: 9/1913
DISPOSAL: 1913
REMARKS: ACCIDENT WITH TRAIN

CAR NUMBER: 28-31
SEATING: 41
DELIVERY CONDITION: READY TO RUN
MFR/MODEL: PC&C, SE, PAYE

LENGTH: 43'6"(13 259 mm)
WIDTH: 8'8"(2 642 mm)
HEIGHT: 12'(3 658 mm)
MOTORS: 4, WH-101-B-2
HORSEPOWER: 40(29.8 kW)
TRUCKS: BRILL 27-GE-1
ROOF TYPE: MONITOR, BULLNOSE ENDS

ORDERED: 12/1910
DELIVERY: 6-7/1911
WITHDRAWN: 1948-1951
DISPOSAL: 1948-1962
REMARKS: 28, FIRE 1943; REBUILT 1946

CAR NUMBER: 24-27
SEATING: 41
DELIVERY CONDITION: READY TO RUN
MFR/MODEL: OCC, SE, PAYE

LENGTH: 43'6"(13 259 mm)
WIDTH: 8'8"(2 642 mm)
HEIGHT: 12'(3 658 mm)
MOTORS: 4, WH-101-B-2
HORSEPOWER: 40(29.8 kW)
TRUCKS: BRILL 27-GE-1
ROOF TYPE: MONITOR, BULLNOSE ENDS

ORDERED: 12/1910
DELIVERY: 8-9/1911
WITHDRAWN: 1948-1951
DISPOSAL: 1948-1951
REMARKS: 24 & 27 REBUILT WITHOUT TRUSS RODS

CAR NUMBER: 32-46 SEATING: 36
DELIVERY CONDITION: ELECTRICS AND AIR BRAKES NOT INSTALLED
MFR/MODEL: ST. LOUIS, DE, PAYE

LENGTH: 45'(13 716 mm) MOTORS: 4, GE-80A-1
WIDTH: 8'8"(2 642 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: ST. LOUIS 47-B
ROOF TYPE: PLAIN ARCH

ORDERED: 2/1912 WITHDRAWN: 1949-1951
DELIVERY: 5-6/1912 DISPOSAL: 1949-1951
REMARKS: REBUILT TO SE; 32, 33, 42 NOW AT FORT EDMONTON PARK

CAR NUMBER: 47-49 SEATING: 44
DELIVERY CONDITION: READY TO RUN
MFR/MODEL: PC&C, SE, PAYE

LENGTH: 45'4.75"(13 837 mm) MOTORS: 4, AC-301
WIDTH: 8'11.5"(2 731 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: STANDARD 0-50
ROOF TYPE: TURTLE BACK

ORDERED: 11/1912 WITHDRAWN: 1951
DELIVERY: 5/1913 DISPOSAL: 1952
REMARKS:

CAR NUMBER: 50 SEATING: 44
DELIVERY CONDITION: READY TO RUN
MFR/MODEL: PC&C, SE, PAYE

LENGTH: 45'4.75"(13 837 mm) MOTORS: 4, GE-80A-1
WIDTH: 8'11.5"(2 731 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: STANDARD 0-50
ROOF TYPE: TURTLE BACK

ORDERED: 11/1912 WITHDRAWN: 6/1918
DELIVERY: 5/1913 DISPOSAL: 6/1918
REMARKS: SOLD TO T&YRR

CAR NUMBER: 51-57 SEATING: 44
DELIVERY CONDITION: READY TO RUN
MFR/MODEL: PC&C, SE, PAYE

LENGTH: 45'4.75"(13 837 mm) MOTORS: 4, GE-80A-1
WIDTH: 8'11.5"(2 731 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: STANDARD 0-50
ROOF TYPE: TURTLE BACK

ORDERED: 11/1912 WITHDRAWN: 1951
DELIVERY: 5-6/1913 DISPOSAL: 1952
REMARKS: NEW ELECTRICS ON 56, 1929

CAR NUMBER: 58 SEATING: 44
DELIVERY CONDITION: READY TO RUN
MFR/MODEL: PC&C, SE, PAYE

LENGTH: 45'4.75"(13 837 mm) MOTORS: 4, GE-80A-1
WIDTH: 8'11.5"(2 731 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: STANDARD 0-50
ROOF TYPE: TURTLE BACK

ORDERED: 11/1912 WITHDRAWN: 6/1918
DELIVERY: 6/1913 DISPOSAL: 6/1918
REMARKS: SOLD TO T&YRR

CAR NUMBER: 59 SEATING: 44
DELIVERY CONDITION: READY TO RUN
MFR/MODEL: PC&C, SE, PAYE

LENGTH: 45'4.75"(13 837 mm) MOTORS: 4, GE-80A-1
WIDTH: 8'11.5"(2 731 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: STANDARD 0-50
ROOF TYPE: TURTLE BACK

ORDERED: 11/1912 WITHDRAWN: 9/1951
DELIVERY: 6/1913 DISPOSAL: 1951
REMARKS:

CAR NUMBER: 60-62 SEATING: 44
DELIVERY CONDITION: READY TO RUN
MFR/MODEL: PC&C, SE, PAYE

LENGTH: 45'4.75"(13 837 mm) MOTORS: 4, WH-101-B-2
WIDTH: 8'11.5"(2 731 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: STANDARD 0-50
ROOF TYPE: TURTLE BACK

ORDERED: 11/1912 WITHDRAWN: 1950-1951
DELIVERY: 6-8/1913 DISPOSAL: 1950-1962
REMARKS: 61 USED AS STORAGE SHED

CAR NUMBER: 63 SEATING: 44
DELIVERY CONDITION: READY TO RUN
MFR/MODEL: PC&C, SE, PAYE

LENGTH: 45'4.75"(13 837 mm) MOTORS: 4, GE-80A-1
WIDTH: 8'11.5"(2 731 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: STANDARD 0-50
ROOF TYPE: TURTLE BACK

ORDERED: 11/1912 WITHDRAWN: 1951
DELIVERY: 9/1913 DISPOSAL: 1952
REMARKS:

CAR NUMBER: 64-74 SEATING: 44
DELIVERY CONDITION: READY TO RUN
MFR/MODEL: PC&C, SE, PAYE

LENGTH: 45'4.75"(13 837 mm) MOTORS: 4, WH-101-B-2
WIDTH: 8'11.5"(2 731 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 12'(3 658 mm) TRUCKS: STANDARD 0-50
ROOF TYPE: TURTLE BACK

ORDERED: 11/1912 WITHDRAWN: 1948-1951
DELIVERY: 8-9/1913 DISPOSAL: 1948-1952
REMARKS: 73 NOW AT FORT EDMONTON PARK

CAR NUMBER: 75-79
SEATING: 44
DELIVERY CONDITION: READY TO RUN
MFR/MODEL: PC&C, SE, PAYE

LENGTH: 45'4.75"(13 837 mm)
WIDTH: 8'11.5"(2 731 mm)
HEIGHT: 12'(3 658 mm)
ROOF TYPE: TURTLE BACK

MOTORS: 4, WH-101-B-2
HORSEPOWER: 40(29.8 kW)
TRUCKS: STANDARD 0-50

ORDERED: 11/1912
DELIVERY: 4-9/1914
REMARKS:

WITHDRAWN: 1951
DISPOSAL: 1952

CAR NUMBER: 81
SEATING: 44
DELIVERY CONDITION: READY TO RUN
MFR/MODEL: PC&C, SE, PAYE

LENGTH: 45'4.75"(13 837 mm)
WIDTH: 8'11.5"(2 731 mm)
HEIGHT: 12'(3 658 mm)
ROOF TYPE: TURTLE BACK

MOTORS: 4, WH-101-B-2
HORSEPOWER: 40(29.8 kW)
TRUCKS: STANDARD 0-50

ORDERED: 11/1912
DELIVERY: 6/1914
REMARKS: SOLD TO OSHAWA

WITHDRAWN: 7/1917
DISPOSAL: 7/1917

CAR NUMBER: 80
SEATING: 44
DELIVERY CONDITION: READY TO RUN
MFR/MODEL: PC&C, SE, PAYE

LENGTH: 45'4.75"(13 837 mm)
WIDTH: 8'11.5"(2 731 mm)
HEIGHT: 12'(3 658 mm)
ROOF TYPE: TURTLE BACK

MOTORS: 4, WH-101-B-2
HORSEPOWER: 40(29.8 kW)
TRUCKS: STANDARD 0-50

ORDERED: 11/1912
DELIVERY: 9/1914
REMARKS: SOLD TO OSHAWA

WITHDRAWN: 7/1917
DISPOSAL: 7/1917

CAR NUMBER: N/A
SEATING: 42
DELIVERY CONDITION: N/A
MFR/MODEL: ERR, SE, OBSERVATION

LENGTH: 42'(12 802 mm)
WIDTH: 8'8"(2 642 mm)
HEIGHT: ?
ROOF TYPE: ARCH
MOTORS: 4, WH-101-B-2
HORSEPOWER: 40 (29.8 kW)
TRUCKS: BRILL 27-GE-1

ORDERED: 1919-1920
DELIVERY: 7/1920
REMARKS: USED FRAME OF 22
WITHDRAWN: 1929
DISPOSAL: 1945

CAR NUMBER: 80/2nd-81/2nd
SEATING: 51
DELIVERY CONDITION: READY TO RUN
MFR/MODEL: OCM, SE, FE-CE

LENGTH: 45'11.11"(13 998 mm)
WIDTH: 8'3"(2 515 mm)
HEIGHT: 10'10.5"(3 315 mm)
ROOF TYPE: PLAIN ARCH
MOTORS: 4, CGE-247L-1
HORSEPOWER: 40(29.8 kW)
TRUCKS: CCF F-920

ORDERED: 6/1930
DELIVERY: 11/1930
WITHDRAWN: 9/1951
DISPOSAL: 1954
REMARKS: SOLD; 80 NOW AT FORT EDMONTON PARK

CAR NUMBER: 82-84
SEATING: 51
DELIVERY CONDITION: READY TO RUN
MFR/MODEL: OCM, SE, FE-CE

LENGTH: 45'11.11"(13 998 mm)
WIDTH: 8'3"(2 515 mm)
HEIGHT: 10'10.5"(3 315 mm)
ROOF TYPE: PLAIN ARCH
MOTORS: 4, CGE-247L-1
HORSEPOWER: 40(29.8 kW)
TRUCKS: CCF F-920

ORDERED: 6/1930
DELIVERY: 11/1930
REMARKS: SCRAPPED
WITHDRAWN: 9/1951
DISPOSAL: 1957

CAR NUMBER: N/A
DELIVERY CONDITION: N/A
MFR/MODEL: ERR, LIBRARY

SEATING: N/A

LENGTH: 42'(12 802 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 12'(3 658 mm)
ROOF TYPE: MONITOR; BULLNOSE ENDS

MOTORS: UNKNOWN
HORSEPOWER: 40(29.8 kW)
TRUCKS: BRILL 27-GE-1

ORDERED: 1941
DELIVERY: 10/1941
REMARKS: BUILT FROM 14

WITHDRAWN: 8/1949
DISPOSAL: 10/1949

CAR NUMBER: 1   SEATING: N/A
DELIVERY CONDITION: ELECTRICS NOT INSTALLED
MFR/MODEL: McG-C, DE, BAGGAGE-SWEEPER

LENGTH: 50'(15 240 mm)   MOTORS: 6, GE-80A-1
WIDTH: HORSEPOWER: 40(29.8 kW)
HEIGHT: TRUCKS: McG-C, MCB 10-A
ROOF TYPE: PLAIN ARCH

ORDERED: 1908   WITHDRAWN: 1951
DELIVERY: 4/1909   DISPOSAL: 1951
REMARKS: CONVERTED TO S.E. IN 1918

CAR NUMBER: S-1   SEATING: N/A
DELIVERY CONDITION: ELECTRICS NOT INSTALLED
MFR/MODEL: PC&C, DE, SPRINKLER

LENGTH: 28'   MOTORS: 2, GE-80A-1
WIDTH: 8'   HORSEPOWER: 40(29.8 kW)
HEIGHT: 10'6"(3 200)   TRUCKS: BEMIS 45
ROOF TYPE: DUCK HOODS

ORDERED: 5/1909   WITHDRAWN: 1921
DELIVERY: 9/1909   DISPOSAL: 1925
REMARKS: TANK SOLD, FRAME USED FOR 5

CAR NUMBER: 2 SEATING: N/A
DELIVERY CONDITION: READY TO RUN
MFR/MODEL: OCC, SE, SWEEPER

LENGTH: 32'(9 754 mm) MOTORS: 3 WH-101-B-2
WIDTH: 7'(2 134 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: TRUCKS: OCC, PEDESTAL
ROOF TYPE: PLAIN ARCH

ORDERED: 8/1910 WITHDRAWN: 1949
DELIVERY: 12/1910 DISPOSAL: 2/1950
REMARKS: RENUMBERED 3 IN 1928

CAR NUMBER: ?S-3? SEATING: N/A
DELIVERY CONDITION: N/A
MFR/MODEL: OCC, ERR, SAND CAR

LENGTH: 31'10"(9 703 mm) MOTORS: 2, GE-80A-1
WIDTH: 8'6"(2 591 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 9'3"(2 819) TRUCKS: BRILL 21-E
ROOF TYPE: MONITOR, STRAIGHT ENDS

BUILT: 8/1908 WITHDRAWN: 4/1915
DELIVERY: BEFORE 10/1911 DISPOSAL: 5/1915
REMARKS: BECAME WORK CAR (LINE CAR)

CAR NUMBER: S-4 SEATING: N/A
DELIVERY CONDITION: ELECTRICS AND AIR BRAKES NOT INSTALLED
MFR/MODEL: McG-C, SE, WORK CAR (FLAT CAR)

LENGTH: MOTORS: 4, WH-101-B-2
WIDTH: HORSEPOWER: 40(29.8 kW)
HEIGHT: TRUCKS: McG-C, MCB 10A
ROOF TYPE: PLAIN ARCH

ORDERED: 2/1912 WITHDRAWN: 1951
DELIVERY: 7/1912 DISPOSAL: 1951
REMARKS: RENUMBERED 4; SCRAPPED

CAR NUMBER: L-1 SEATING: N/A
DELIVERY CONDITION: READY TO RUN
MFR/MODEL: ERR, DE, LINE CAR

LENGTH: 38' MOTORS: 2, GE-80A-1
WIDTH: 8'3" HORSEPOWER: 40(29.8 kW)
HEIGHT: 14'5.5"(4 407) TRUCKS: BEMIS 45
ROOF TYPE: PLAIN ARCH

ORDERED: 1/1913 WITHDRAWN: 1951
DELIVERY: 4/1913 DISPOSAL: 1952
REMARKS: REBUILT TO SE IN 1918; RENUMBERED S-5

CAR NUMBER: S-5 SEATING: N/A
DELIVERY CONDITION: NO AIR BRAKES
MFR/MODEL: CCF/SIMPLEX, SE, DIFFERENTIAL DUMP CAR

LENGTH: MOTORS: 4, GE-80A-1
WIDTH: HORSEPOWER: 40(29.8 kW)
HEIGHT: TRUCKS: CCF, CLASS 110 FREIGHT
ROOF TYPE: FLAT PITCHED

ORDERED: 10/1912 WITHDRAWN: 7/1918
DELIVERY: 4/1913 DISPOSAL: 9/1918
REMARKS: SOLD

CAR NUMBER: S-2 SEATING: N/A
DELIVERY CONDITION: ELECTRICS AND AIR BRAKES NOT INSTALLED
MFR/MODEL: McG-C, DE, SPRINKLER

LENGTH: 28'9"(8 763) MOTORS: 4, WH-101-B-2
WIDTH: 7'6"(2 286) HORSEPOWER: 40(29.8 kW)
HEIGHT: 10'11"(3 327) TRUCKS: McG-C, S-E 60
ROOF TYPE: WOODEN HOODS

ORDERED: 4/1913 WITHDRAWN: 1924
DELIVERY: 5/1913 DISPOSAL: 1925
REMARKS: FRAME USED FOR 6

CAR NUMBER: ?S-6? SEATING: N/A
DELIVERY CONDITION: READY TO RUN
MFR/MODEL: ERR, FLAT CAR

LENGTH: SEE TEXT MOTORS: N/A
WIDTH: SEE TEXT HORSEPOWER: N/A
HEIGHT: SEE TEXT TRUCKS: SEE TEXT
ROOF TYPE: N/A

ORDERED: 12/1913 WITHDRAWN: 1922
DELIVERY: 5/1914 DISPOSAL: 1922
REMARKS: UNMOTORIZED UNIT

CAR NUMBER: ?S-3? SEATING: N/A
DELIVERY CONDITION: N/A
MFR/MODEL: OCC, ERR, SE, WORK CAR (LINE CAR)

LENGTH: 31'10"(9 703 mm) MOTORS: 2, GE-80A-1
WIDTH: 8'6"(2 591 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: 9'3"(2 819) TRUCKS: BRILL 21-E
ROOF TYPE: MONITOR, STRAIGHT ENDS

BUILT: 8/1908 WITHDRAWN: 11/1918
DELIVERY: 5/1915 DISPOSAL: 11/1918
REMARKS: USED FOR PASSENGER SERVICE

CAR NUMBER: 2/2nd SEATING: N/A
DELIVERY CONDITION: N/A
MFR/MODEL: ERR, SE, SWEEPER

LENGTH: 38'6.5"(11 748 mm) MOTORS: 5, GE-80A-1
WIDTH: 8'6"(2 591 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: TRUCKS: BRILL 27-GE-1
ROOF TYPE: PLAIN ARCH

BUILT: 8/1908 WITHDRAWN: 1951
DELIVERY: 11/1918 DISPOSAL: 1951
REMARKS: USED FRAME OF PASSENGER CAR 2

CAR NUMBER: 5
SEATING: N/A
DELIVERY CONDITION: N/A
MFR/MODEL: ERR, SE, BALLAST SPREADER

LENGTH: 28'
WIDTH: 8'
HEIGHT:
ROOF TYPE: PLAIN ARCH
MOTORS:
HORSEPOWER:
TRUCKS: BEMIS 45

ORDERED: N/A
DELIVERY: 9/1922
REMARKS: USED FRAME OF S-1
WITHDRAWN: 1951
DISPOSAL: 1951

CAR NUMBER: 6
SEATING: N/A
DELIVERY CONDITION: N/A
MFR/MODEL: ERR, DE, WRECKER

LENGTH:
WIDTH: 7'6"(2 286)
HEIGHT:
ROOF TYPE: PLAIN ARCH
MOTORS:
HORSEPOWER:
TRUCKS: McG-C, S-E 60

ORDERED: N/A
DELIVERY: 7/1925
REMARKS: USED FRAME OF S-2
WITHDRAWN: 1951
DISPOSAL: 1951

CAR NUMBER: N/A
SEATING: N/A
DELIVERY CONDITION: N/A
MFR/MODEL: ERR, SE, WEED KILLER

LENGTH: 20'10"(6 350)
WIDTH: 8'6"(2 591 mm)
HEIGHT:
ROOF TYPE: NONE
MOTORS: NONE
HORSEPOWER: N/A
TRUCKS: BRILL 21-E

ORDERED: N/A
DELIVERY: 1928
REMARKS: FORMER PASSENGER CAR 7
WITHDRAWN: 1937
DISPOSAL: 1937

CAR NUMBER: N/A SEATING: N/A
DELIVERY CONDITION: N/A
MFR/MODEL: SRD, DE, RAIL GRINDER

LENGTH: 20'10" (6 350) MOTORS: 2, GE-80A-1
WIDTH: 8'6"(2 591 mm) HORSEPOWER: 40(29.8 kW)
HEIGHT: TRUCKS: BRILL 21-E
ROOF TYPE: NONE

ORDERED: N/A WITHDRAWN: 1951
DELIVERY: 1937 DISPOSAL: 1951
REMARKS: FORMER WEED KILLER, SCRAPPED

CAR NUMBER: 1001-1014	SEATING: 64

DELIVERY CONDITION: ELECTRICS AND INTERIORS UNASSEMBLED
MFR/MODEL: DUEWAG/SIEMENS, RTE1, DE, MU

LENGTH: 24 284 mm	MOTORS: 2, SIEMENS 1KB2021-5MB02
WIDTH: 2 650 mm	HORSEPOWER: 201 (150 kW)
HEIGHT: 3 320 mm	TRUCKS: DUEWAG
ROOF TYPE: PLAIN ARCH	

ORDERED: 11/1974	WITHDRAWN: N/A
DELIVERY: 4-8/1977	DISPOSAL: N/A

REMARKS: SOME MODIFICATIONS, 1980

CAR NUMBER: 1015-1017	SEATING: 64

DELIVERY CONDITION: ELECTRICS AND INTERIORS UNASSEMBLED
MFR/MODEL: DUEWAG/SIEMENS, RTE1, DE, MU

LENGTH: 24 284 mm	MOTORS: 2, SIEMENS 1KB2021-5MB02
WIDTH: 2 650 mm	HORSEPOWER: 201 (150 kW)
HEIGHT: 3 320 mm	TRUCKS: DUEWAG
ROOF TYPE: PLAIN ARCH	

ORDERED: 1978	WITHDRAWN: N/A
DELIVERY: 8/1979	DISPOSAL: N/A

REMARKS: SOME DIFFERENCES FROM 1001-1014

CAR NUMBER: 1018-1021 SEATING: 64
DELIVERY CONDITION: ELECTRICS AND INTERIORS UNASSEMBLED
MFR/MODEL: DUEWAG/SIEMENS, RTE1, DE, MU

LENGTH: 24 284 mm MOTORS: 2, SIEMENS 1KB2021-5MB02
WIDTH: 2 650 mm HORSEPOWER: 201 (150 kW)
HEIGHT: 3 320 mm TRUCKS: DUEWAG
ROOF TYPE: PLAIN ARCH

ORDERED: 1981 WITHDRAWN: N/A
DELIVERY: 12/1982 DISPOSAL: N/A
REMARKS: SOME DIFFERENCES FROM 1015-1017

CAR NUMBER: 1022-1037 SEATING: 64
DELIVERY CONDITION: ELECTRICS AND INTERIORS UNASSEMBLED
MFR/MODEL: DUEWAG/SIEMENS, RTE1, DE, MU

LENGTH: 24 284 mm MOTORS: 2, SIEMENS 1KB2021-5MB02
WIDTH: 2 650 mm HORSEPOWER: 201 (150 kW)
HEIGHT: 3 320 mm TRUCKS: DUEWAG
ROOF TYPE: PLAIN ARCH

ORDERED: 1981 WITHDRAWN: N/A
DELIVERY: 1-2/1983 DISPOSAL: N/A
REMARKS: SOME DIFFERENCES FROM 1015-1017

CAR NUMBER: 2001 SEATING: 51069
DELIVERY CONDITION: NEEDED REPAIRS
MFR/MODEL: ALCO (1912), CENTRE-CAB LOCOMOTIVE

LENGTH: MOTORS: 4, GE
WIDTH: HORSEPOWER:
HEIGHT: TRUCKS: ALCO
ROOF TYPE: PLAIN ARCH

PURCHASED: 1979 WITHDRAWN: N/A
DELIVERY: 3/1980 DISPOSAL: N/A
REMARKS: REFURBISHED BY ET

CAR NUMBER: 2101 SEATING: N/A
DELIVERY CONDITION: NAR BOX CAR
MFR/MODEL: ET, FLAT CAR

LENGTH: 32' (9 754 mm) MOTORS: N/A
WIDTH: HORSEPOWER: N/A
HEIGHT: TRUCKS: ARCH BAR
ROOF TYPE: N/A

BUILT: 1980 WITHDRAWN: N/A
DELIVERY: 1980 DISPOSAL: N/A
REMARKS:

CAR NUMBER: 2102 SEATING: N/A
DELIVERY CONDITION: NAR IDLER CAR
MFR/MODEL: ET, FLAT CAR

LENGTH: 40' (12 192 mm) MOTORS: N/A
WIDTH: HORSEPOWER: N/A
HEIGHT: TRUCKS: BETTENDORF
ROOF TYPE: N/A

BUILT: 1980 WITHDRAWN: N/A
DELIVERY: 1980 DISPOSAL: N/A
REMARKS:

CAR NUMBER: 2103 SEATING: N/A
DELIVERY CONDITION: VARIOUS PARTS
MFR/MODEL: ET, FLAT CAR

LENGTH: 40' (12 192 mm) MOTORS: N/A
WIDTH: HORSEPOWER: N/A
HEIGHT: TRUCKS: BETTENDORF
ROOF TYPE: N/A

BUILT: 1980 WITHDRAWN: N/A
DELIVERY: 1980 DISPOSAL: N/A
REMARKS:

CAR NUMBER: 2201 SEATING: N/A
DELIVERY CONDITION: NAR PLOW CAR
MFR/MODEL: ET/KML, DEPRESSED CENTRE FLAT CAR

LENGTH: 40' (12 192 mm) MOTORS: N/A
WIDTH: HORSEPOWER: N/A
HEIGHT: TRUCKS: BETTENDORF
ROOF TYPE: N/A

BUILT: 1980 WITHDRAWN: N/A
DELIVERY: 1981 DISPOSAL: N/A
REMARKS:

CAR NUMBER: 2301 SEATING: N/A
DELIVERY CONDITION: NAR TANK CAR
MFR/MODEL: ET/KML, DIFFERENTIAL DUMP CAR

LENGTH: 40' (12 192 mm) MOTORS: N/A
WIDTH: 8'5" (2 591 mm) HORSEPOWER: N/A
HEIGHT: TRUCKS: BETTENDORF
ROOF TYPE: N/A

BUILT: 1980 WITHDRAWN: 7/1981
DELIVERY: 1980 DISPOSAL: 1981
REMARKS: MISHAP WHILE DUMPING, SCRAPPED

CAR NUMBER: 2302-2303 SEATING: N/A
DELIVERY CONDITION: NAR TANK CARS
MFR/MODEL: ET/KML, DIFFERENTIAL DUMP CAR

LENGTH: 40' (12 192 mm) MOTORS: N/A
WIDTH: 8'5" (2 591 mm) HORSEPOWER: N/A
HEIGHT: TRUCKS: BETTENDORF
ROOF TYPE: N/A

BUILT: 1980 WITHDRAWN: N/A
DELIVERY: 1980 DISPOSAL: N/A
REMARKS:

CAR NUMBER: 2304 SEATING: N/A
DELIVERY CONDITION: NAR TANK CAR
MFR/MODEL: ET/KML, DIFFERENTIAL DUMP CAR

LENGTH: 40' (12 192 mm) MOTORS: N/A
WIDTH: 8'5" (2 591 mm) HORSEPOWER: N/A
HEIGHT: TRUCKS: BETTENDORF
ROOF TYPE: N/A

BUILT: 1980 WITHDRAWN: 12/1980
DELIVERY: 1980 DISPOSAL: 1981
REMARKS: FRAME BROKE IN SERVICE, SCRAPPED

CAR NUMBER: 2305-2307 SEATING: N/A
DELIVERY CONDITION: NAR TANK CARS
MFR/MODEL: ET/KML, DIFFERENTIAL DUMP CAR

LENGTH: 40' (12 192 mm) MOTORS: N/A
WIDTH: 8'5" (2 591 mm) HORSEPOWER: N/A
HEIGHT: TRUCKS: BETTENDORF
ROOF TYPE: N/A

BUILT: 1980 WITHDRAWN: N/A
DELIVERY: 1980 DISPOSAL: N/A
REMARKS:

CAR NUMBER: 2308 SEATING: N/A
DELIVERY CONDITION: NAR IDLER CAR
MFR/MODEL: ET/KML, DIFFERENTIAL DUMP CAR

LENGTH: 40' (12 192 mm) MOTORS: N/A
WIDTH: 8'5" (2 591 mm) HORSEPOWER: N/A
HEIGHT: TRUCKS: BETTENDORF
ROOF TYPE: N/A

BUILT: 1980 WITHDRAWN: N/A
DELIVERY: 1980 DISPOSAL: N/A
REMARKS:

CAR NUMBER: 2309 SEATING: N/A
DELIVERY CONDITION: NAR TANK CAR
MFR/MODEL: ET/KML, DIFFERENTIAL DUMP CAR

LENGTH: 32' (9 754 mm) MOTORS: N/A
WIDTH: 8'5" (2 591 mm) HORSEPOWER: N/A
HEIGHT: TRUCKS: BETTENDORF
ROOF TYPE: N/A

BUILT: 1980 WITHDRAWN: N/A
DELIVERY: 1980 DISPOSAL: N/A
REMARKS: NO END PLATFORMS

CAR NUMBER: 2310	SEATING: N/A
DELIVERY CONDITION: NAR STOCK CAR	
MFR/MODEL: ET/KML, DIFFERENTIAL DUMP CAR	
LENGTH: 40' (12 192 mm)	MOTORS: N/A
WIDTH: 8'5" (2 591 mm)	HORSEPOWER: N/A
HEIGHT:	TRUCKS: BETTENDORF
ROOF TYPE: N/A	
BUILT: 1980	WITHDRAWN: N/A
DELIVERY: 1980	DISPOSAL: N/A
REMARKS:	

This section of the Appendix contains a chronological listing of all new and used motor buses obtained and operated between 1932 and 1981. This section also includes a listing of leased motor buses used by the City at various times.

The information includes: the bus number, the serial number (if available), the manufacturers and the model designation, major dimensions, vehicle weight, engine designation and rating, fueltype, seating capacity, order and delivery dates, disposal date, and any cogent remarks.

BUS NUMBER: 1
SERIAL NUMBER:

MFR/MODEL: CHASSIS-LEYLAND LKP.3 "CUB", BODY - CCF

LENGTH: 24'(7 315 mm)
WIDTH:
HEIGHT:
WEIGHT: 9,700 lbs.(4 400 kg)

ENGINE: LEYLAND 6-CYL.
HORSEPOWER: 68(50.7 kW)
FUEL: GASOLINE
SEATING: 21

ORDERED: 1/1932
DELIVERY: 1/1932

WITHDRAWN: 1944
DISPOSAL: 8/1944

REMARKS: BLT. 1931, RE-ENGINED 1936, LEYLAND DIESEL 70 H.P.(52.2 kW)

BUS NUMBER: 2
SERIAL NUMBER:

MFR/MODEL: CHASSIS - WHITE 613, BODY - CCF

LENGTH:
WIDTH:
HEIGHT:
WEIGHT: 10,000 lbs.(4 536 kg)

ENGINE: WHITE 6-CYL.
HORSEPOWER: 70(52.2 kW)
FUEL: GASOLINE
SEATING: 21

ORDERED: 1/1932
DELIVERY: 3/1932

WITHDRAWN: 5/1947
DISPOSAL: 1947

REMARKS:

BUS NUMBER: 3	SERIAL NUMBER:

MFR/MODEL: CHASSIS-G.M.C. U, BODY-FANE AUTO WORKS, EDMONTON

LENGTH:	ENGINE: BUICK 6-CYL.
WIDTH:	HORSEPOWER: 94(70 kW)
HEIGHT:	FUEL: GASOLINE
WEIGHT: 13,650 lbs.(6 192 kg)	SEATING: 25

ORDERED: 1/1932	WITHDRAWN: 1944
DELIVERY: 4/1932	DISPOSAL: 8/1944

REMARKS: RE-ENGINED 1936, LEYLAND DIESEL 70 H.P.(52.2 kW)

BUS NUMBER: 4	SERIAL NUMBER:

MFR/MODEL: CHASSIS-LEYLAND LTB.1 "LIONESS", BODY - TTC

LENGTH: 30'8"(9 347 mm)	ENGINE: LEYLAND 6-CYL.
WIDTH: 8'(2 438 mm)	HORSEPOWER: 100(74.6 kW)
HEIGHT: 9'(2 743 mm)	FUEL: GASOLINE
WEIGHT: 14,380 lbs.(6 523 kg)	SEATING: 27

BUILT: 1930	WITHDRAWN: 8/1947
DELIVERY: 9/1939	DISPOSAL: 1947

REMARKS: FROM TTC ex 558, CONVERTED TO BOOKMOBILE

BUS NUMBER: 5	SERIAL NUMBER: 1376

MFR/MODEL: CHASSIS-LEYLAND LKPZ.4 "CUB", BODY-SMITH BROS.

LENGTH: 24'(7 315 mm)	ENGINE: LEYLAND H2B 6-CYL.
WIDTH:	HORSEPOWER:
HEIGHT:	FUEL: DIESEL
WEIGHT: 11,540 lbs.(5 235 kg)	SEATING: 23

ORDERED: 1939	WITHDRAWN: 1954
DELIVERY: 12/1939	DISPOSAL: 1954

REMARKS: RE-ENGINED 1949, CHRYSLER GASOLINE; PRESERVED BY ETS

BUS NUMBER: 6
SERIAL NUMBER:

MFR/MODEL: CHASSIS-LEYLAND LKPZ.4 "CUB", BODY-SMITH BROS.

LENGTH: 24'(7 315 mm)
WIDTH:
HEIGHT:
WEIGHT: 11,540 lbs.(5 235 kg)

ENGINE: LEYLAND H2B 6-CYL.
HORSEPOWER:
FUEL: DIESEL
SEATING: 23

ORDERED: 2/1940
DELIVERY: 4/1940

WITHDRAWN: 1951
DISPOSAL: 1951

REMARKS: RE-ENGINED 1949, CONVERTED TO BOOKMOBILE

BUS NUMBER: 7
SERIAL NUMBER: 4735

MFR/MODEL: CHASSIS-LEYLAND LTB.S "LIONESS", BODY-SMITH BROS.

LENGTH:
WIDTH:
HEIGHT:
WEIGHT: 16,000 lbs.(7 258 kg)

ENGINE: LEYLAND "TIGER" 6-CYL.
HORSEPOWER: 58(43.3 kW)
FUEL: DIESEL
SEATING: 27

ORDERED: 5/1940
DELIVERY: 10/1940

WITHDRAWN: 1954
DISPOSAL: 1954

REMARKS: RE-ENGINED 1949, CHRYSLER GASOLINE

BUS NUMBER: 8
SERIAL NUMBER: 13156

MFR/MODEL: CHASSIS-LEYLAND LTS.8 "TIGER", BODY-SMITH BROS.

LENGTH:
WIDTH:
HEIGHT:
WEIGHT: 16,125 lbs.(7 314 kg)

ENGINE: LEYLAND "TIGER" 6-CYL.
HORSEPOWER: 58(43.3 kW)
FUEL: DIESEL
SEATING: 30

ORDERED: 2/1941
DELIVERY: 3/1941

WITHDRAWN: 1954
DISPOSAL: 1954

REMARKS: RE-ENGINED 1949, CHRYSLER GASOLINE

BUS NUMBER: 9 SERIAL NUMBER: 13157

MFR/MODEL: CHASSIS-LEYLAND LTS.8 "TIGER", BODY-SMITH BROS.

LENGTH:	ENGINE: LEYLAND "TIGER" 6-CYL.
WIDTH:	HORSEPOWER: 58(43.3 kW)
HEIGHT:	FUEL: DIESEL
WEIGHT: 16,125 lbs.(7 314 kg)	SEATING: 30

ORDERED: 2/1941	WITHDRAWN: 1954
DELIVERY: 3/1941	DISPOSAL: 1954

REMARKS: RE-ENGINED 1949, CHRYSLER GASOLINE

BUS NUMBER: 10 SERIAL NUMBER: 13237

MFR/MODEL: CHASSIS-LEYLAND LTS.8 "TIGER", BODY-SMITH BROS.

LENGTH:	ENGINE: LEYLAND "TIGER" 6-CYL.
WIDTH:	HORSEPOWER: 58(43.3 kW)
HEIGHT:	FUEL: DIESEL
WEIGHT: 16,125 lbs.(7 314 kg)	SEATING: 30

ORDERED: 9/1941	WITHDRAWN: 1954
DELIVERY: 12/1941	DISPOSAL: 1954

REMARKS: RE-ENGINED 1949, CHRYSLER GASOLINE

BUS NUMBER: 11 SERIAL NUMBER: 99T-570514

MFR/MODEL: FORD, 29B "VICTORY"

LENGTH: 25'9"(7 849 mm)	ENGINE: FORD V-8
WIDTH: 8'(2 438 mm)	HORSEPOWER: 100(74.6 kW)
HEIGHT: 9'1"(2 775 mm)	FUEL: GASOLINE
WEIGHT: 10,000 lbs.(4 536 kg)	SEATING: 27

ORDERED: 8/1943	WITHDRAWN: 1954
DELIVERY: 11/1943	DISPOSAL: 1954

REMARKS:

BUS NUMBER: 12
SERIAL NUMBER: 99T-570515

MFR/MODEL: FORD, 29B "VICTORY"

LENGTH: 25'9"(7 849 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 9'1"(2 775 mm)
WEIGHT: 10,000 lbs.(4 536 kg)

ENGINE: FORD V-8
HORSEPOWER: 100(74.6 kW)
FUEL: GASOLINE
SEATING: 27

ORDERED: 8/1943
DELIVERY: 12/1943
REMARKS:

WITHDRAWN: 1954
DISPOSAL: 1954

BUS NUMBER: 13
SERIAL NUMBER: 99TF-577029

MFR/MODEL: FORD, 29B "VICTORY"

LENGTH: 25'9"(7 849 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 9'1"(2 775 mm)
WEIGHT: 10,000 lbs.(4 536 kg)

ENGINE: FORD V-8
HORSEPOWER: 100(74.6 kW)
FUEL: GASOLINE
SEATING: 27

ORDERED: 8/1943
DELIVERY: 12/1943
REMARKS:

WITHDRAWN: 1954
DISPOSAL: 1954

BUS NUMBER: 14
SERIAL NUMBER: 99T-50774

MFR/MODEL: FORD, 29B "VICTORY"

LENGTH: 25'9"(7 849 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 9'1"(2 775 mm)
WEIGHT: 10,000 lbs.(4 536 kg)

ENGINE: FORD V-8
HORSEPOWER: 100(74.6 kW)
FUEL: GASOLINE
SEATING: 27

ORDERED: 4/1944
DELIVERY: 12/1944
REMARKS: CONVERTED TO PROPANE, 12/1949

WITHDRAWN:
DISPOSAL:

7

BUS NUMBER: 15
SERIAL NUMBER: 99T-587898

MFR/MODEL: FORD, 29B "VICTORY"

LENGTH: 25'9"(7 849 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 9'1"(2 775 mm)
WEIGHT: 10,000 lbs.(4 536 kg)

ENGINE: FORD V-8
HORSEPOWER: 100(74.6 kW)
FUEL: GASOLINE
SEATING: 27

ORDERED: 4/1944
DELIVERY: 12/1944
REMARKS:

WITHDRAWN: 1954
DISPOSAL: 1954

BUS NUMBER: 16
SERIAL NUMBER: 99T-587902

MFR/MODEL: FORD, 29B "VICTORY"

LENGTH: 25'9"(7 849 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 9'1"(2 775 mm)
WEIGHT: 10,000 lbs.(4 536 kg)

ENGINE: FORD V-8
HORSEPOWER: 100(74.6 kW)
FUEL: GASOLINE
SEATING: 27

ORDERED: 4/1944
DELIVERY: 1/1945
REMARKS: SOLD

WITHDRAWN: 1951
DISPOSAL: 1951

BUS NUMBER: 17-28
SERIAL NUMBER: 46-2167 - 46-2178

MFR/MODEL: CCF-BRILL, C-36

LENGTH: 30'9.5"(9 385 mm)
WIDTH: 7'11.75"(2 432 mm)
HEIGHT: 9'6"(2 896 mm)
WEIGHT: 15,085 lbs.(6 843 kg)

ENGINE: HALL-SCOTT 136, 6-CYL.
HORSEPOWER: 150(112 kW)
FUEL: GASOLINE
SEATING: 36

ORDERED: 12/1945
DELIVERY: 12/1946
REMARKS: SOLD OR SCRAPPED

WITHDRAWN: 1959-1969
DISPOSAL: 1959-1969

BUS NUMBER: 29-35	SERIAL NUMBER: 47-2217 - 47-2223
MFR/MODEL: CCF-BRILL, C-36	
LENGTH: 30'9.5"(9 385 mm)	ENGINE: HALL-SCOTT 136, 6-CYL.
WIDTH: 7'11.75"(2 432 mm)	HORSEPOWER: 150(112 kW)
HEIGHT: 9'6"(2 896 mm)	FUEL: GASOLINE
WEIGHT: 15,085 lbs.(6 843 kg)	SEATING: 36
ORDERED: 2/1946	WITHDRAWN: 1957-1968
DELIVERY: 1947	DISPOSAL: 1957-1968
REMARKS: SOLD OR SCRAPPED	

BUS NUMBER: 36	SERIAL NUMBER: 47-2651
MFR/MODEL: CCF-BRILL, C-36	
LENGTH: 30'9.5"(9 385 mm)	ENGINE: HALL-SCOTT 136, 6-CYL.
WIDTH: 7'11.75"(2 432 mm)	HORSEPOWER: 150(112 kW)
HEIGHT: 9'6"(2 896 mm)	FUEL: GASOLINE
WEIGHT: 15,085 lbs.(6 843 kg)	SEATING: 36
ORDERED: 12/1947	WITHDRAWN: 1968
DELIVERY: 1/1948	DISPOSAL: 11/1968
REMARKS: SOLD	

BUS NUMBER: 37	SERIAL NUMBER: 47-2652
MFR/MODEL: CCF-BRILL, C-36	
LENGTH: 30'9.5"(9 385 mm)	ENGINE: HALL-SCOTT 136, 6-CYL.
WIDTH: 7'11.75"(2 432 mm)	HORSEPOWER: 150(112 kW)
HEIGHT: 9'6"(2 896 mm)	FUEL: GASOLINE
WEIGHT: 15,085 lbs.(6 843 kg)	SEATING: 36
ORDERED: 12/1947	WITHDRAWN: 1968
DELIVERY: 1/1948	DISPOSAL: N/A
REMARKS: PRESERVED BY ETS	

BUS NUMBER: 38-40
SERIAL NUMBER: 48-2719 - 48-2721

MFR/MODEL: CCF-BRILL, C-36

LENGTH: 30'9.5"(9 385 mm)
WIDTH: 7'11.75"(2 432 mm)
HEIGHT: 9'6"(2 896 mm)
WEIGHT: 15,085 lbs.(6 843 kg)

ENGINE: HALL-SCOTT 136, 6-CYL.
HORSEPOWER: 150(112 kW)
FUEL: GASOLINE
SEATING: 36

ORDERED: 12/1947
DELIVERY: 1948
REMARKS: SOLD

WITHDRAWN: 1967-1969
DISPOSAL: 1967-1970

BUS NUMBER: 41-42
SERIAL NUMBER: 48-2764, 48-2765

MFR/MODEL: CCF-BRILL, C-36

LENGTH: 30'9.5"(9 385 mm)
WIDTH: 7'11.75"(2 432 mm)
HEIGHT: 9'6"(2 896 mm)
WEIGHT: 15,085 lbs.(6 843 kg)

ENGINE: HALL-SCOTT 136, 6-CYL.
HORSEPOWER: 150(112 kW)
FUEL: GASOLINE
SEATING: 36

ORDERED: 1948
DELIVERY: 10/1948
REMARKS: SOLD

WITHDRAWN: 1969
DISPOSAL: 1969

BUS NUMBER: 43
SERIAL NUMBER: 48-2766

MFR/MODEL: CCF-BRILL, C-36

LENGTH: 30'9.5"(9 385 mm)
WIDTH: 7'11.75"(2 432 mm)
HEIGHT: 9'6"(2 896 mm)
WEIGHT: 15,085 lbs.(6 843 kg)

ENGINE: HALL-SCOTT 136, 6-CYL.
HORSEPOWER: 150(112 kW)
FUEL: GASOLINE
SEATING: 36

ORDERED: 1948
DELIVERY: 10/1948
REMARKS: RENUMBERED 99, PRESERVED BY ETS

WITHDRAWN: 1969
DISPOSAL: 1969

BUS NUMBER: 44-45

SERIAL NUMBER: 48-2767, 48-2768

MFR/MODEL: CCF-BRILL, C-36

LENGTH: 30'9.5"(9 385 mm)
WIDTH: 7'11.75"(2 432 mm)
HEIGHT: 9'6"(2 896 mm)
WEIGHT: 15,085 lbs.(6 843 kg)

ENGINE: HALL-SCOTT 136, 6-CYL.
HORSEPOWER: 150(112 kW)
FUEL: GASOLINE
SEATING: 36

ORDERED: 1948
DELIVERY: 10/1948
REMARKS: SOLD

WITHDRAWN: 1969
DISPOSAL: 1969

BUS NUMBER: 46-53

SERIAL NUMBER: 50-2879 - 50-2886

MFR/MODEL: CCF-BRILL, C-36

LENGTH: 30'9.5"(9 385 mm)
WIDTH: 7'11.75"(2 432 mm)
HEIGHT: 9'6"(2 896 mm)
WEIGHT: 15,085 lbs.(6 843 kg)

ENGINE: HALL-SCOTT 136, 6-CYL.
HORSEPOWER: 150(112 kW)
FUEL: GASOLINE
SEATING: 36

ORDERED: 1/1950
DELIVERY: 3/1950
REMARKS: SOLD

WITHDRAWN: 1969
DISPOSAL: 1969-1971

BUS NUMBER: 54-58

SERIAL NUMBER: 652-C - 656-C

MFR/MODEL: TWIN COACH, 44S

LENGTH: 34'10"(10 617 mm)
WIDTH: 7'11.8"(2 433 mm)
HEIGHT: 9'4.5"(2 858 mm)
WEIGHT: 15,000 lbs.(6 804 kg)

ENGINE: FTC 180
HORSEPOWER: 175(130.6 kW)
FUEL: GASOLINE
SEATING: 44

ORDERED: 1/1950
DELIVERY: 6-7/1950
REMARKS: SOLD OR SCRAPPED

WITHDRAWN: 1972-1975
DISPOSAL: 1972-1976

BUS NUMBER: 59
SERIAL NUMBER: 657-C

MFR/MODEL: TWIN COACH, 44S

LENGTH: 34'10"(10 617 mm)
WIDTH: 7'11.8"(2 433 mm)
HEIGHT: 9'4.5"(2 858 mm)
WEIGHT: 15,000 lbs.(6 804 kg)

ENGINE: FTC 180
HORSEPOWER: 180(134.3 kW)
FUEL: PROPANE
SEATING: 44

ORDERED: 1/1950
DELIVERY: 7/1950
REMARKS: CONVERTED TO PROPANE AT FACTORY; PRESERVED BY ETS

WITHDRAWN: 1975
DISPOSAL: N/A

BUS NUMBER: 60-69
SERIAL NUMBER: 96-C - 105-C

MFR/MODEL: TWIN COACH, 45S

LENGTH: 34'10"(10 617 mm)
WIDTH: 7'11.8"(2 443 mm)
HEIGHT: 9'4.5"(2 858 mm)
WEIGHT: 15,500 lbs.(7 031 kg)

ENGINE: FTC 210
HORSEPOWER: 210(156.6 kW)
FUEL: PROPANE
SEATING: 45

ORDERED: 8/1950
DELIVERY: 12/1950
REMARKS: SOLD OR SCRAPPED

WITHDRAWN: 1971-1975
DISPOSAL: 1971-1976

BUS NUMBER: 70-82
SERIAL NUMBER: 152-C - 164-C

MFR/MODEL: TWIN COACH, 45S

LENGTH: 34'10"(10 617 mm)
WIDTH: 7'11.8"(2 443 mm)
HEIGHT: 9'4.5"(2 858 mm)
WEIGHT: 15,500 lbs.(7 031 kg)

ENGINE: FTC 210
HORSEPOWER: 210(156.6 kW)
FUEL: PROPANE
SEATING: 45

ORDERED: 12/1950
DELIVERY: 4/1951
REMARKS: SOLD OR SCRAPPED

WITHDRAWN: 1972-1975
DISPOSAL: 1972-1976

BUS NUMBER: 83
SERIAL NUMBER: 46-2001

MFR/MODEL: CCF-BRILL, C-36

LENGTH: 30'9.5"(9 385 mm)
WIDTH: 7'11.75"(2 432 mm)
HEIGHT: 9'6"(2 896 mm)
WEIGHT: 15,085 lbs.(6 843 kg)

ENGINE: HALL-SCOTT 136, 6-CYL.
HORSEPOWER: 150(112 kW)
FUEL: GASOLINE
SEATING: 36

BUILT: 1946
DELIVERY: 5/1951
WITHDRAWN: 1967
DISPOSAL: 1968
REMARKS: FROM ST. JOHN, N.B., ex 88

BUS NUMBER: 84
SERIAL NUMBER: 46-2002

MFR/MODEL: CCF-BRILL, C-36

LENGTH: 30'9.5"(9 385 mm)
WIDTH: 7'11.75"(2 432 mm)
HEIGHT: 9'6"(2 896 mm)
WEIGHT: 15,085 lbs.(6 843 kg)

ENGINE: HALL-SCOTT 136, 6-CYL.
HORSEPOWER: 150(112 kW)
FUEL: GASOLINE
SEATING: 36

BUILT: 1946
DELIVERY: 5/1951
WITHDRAWN: 1966
DISPOSAL: 1967
REMARKS: FROM ST. JOHN, N.B., ex 90

BUS NUMBER: 85
SERIAL NUMBER: 46-2004

MFR/MODEL: CCF-BRILL, C-36

LENGTH: 30'9.5"(9 385 mm)
WIDTH: 7'11.75"(2 432 mm)
HEIGHT: 9'6"(2 896 mm)
WEIGHT: 15,085 lbs.(6 843 kg)

ENGINE: HALL-SCOTT 136, 6-CYL.
HORSEPOWER: 150(112 kW)
FUEL: GASOLINE
SEATING: 36

BUILT: 1946
DELIVERY: 5/1951
WITHDRAWN: 5/1967
DISPOSAL: 1967
REMARKS: FROM ST. JOHN, N.B., ex 94

BUS NUMBER: 86
SERIAL NUMBER: 46-2005

MFR/MODEL: CCF-BRILL, C-36

LENGTH: 30'9.5"(9 385 mm)
WIDTH: 7'11.75"(2 432 mm)
HEIGHT: 9'6"(2 896 mm)
WEIGHT: 15,085 lbs.(6 843 kg)

ENGINE: HALL-SCOTT 136, 6-CYL.
HORSEPOWER: 150(112 kW)
FUEL: GASOLINE
SEATING: 36

BUILT: 1946
DELIVERY: 5/1951
WITHDRAWN: 1967
DISPOSAL: 1968
REMARKS: FROM ST. JOHN, N.B., ex 96

BUS NUMBER: 87
SERIAL NUMBER: 46-2006

MFR/MODEL: CCF-BRILL, C-36

LENGTH: 30'9.5"(9 385 mm)
WIDTH: 7'11.75"(2 432 mm)
HEIGHT: 9'6"(2 896 mm)
WEIGHT: 15,085 lbs.(6 843 kg)

ENGINE: HALL-SCOTT 136, 6-CYL.
HORSEPOWER: 150(112 kW)
FUEL: GASOLINE
SEATING: 36

BUILT: 1946
DELIVERY: 5/1951
WITHDRAWN: 11/1966
DISPOSAL: 1967
REMARKS: FROM ST. JOHN, N.B., ex 98

BUS NUMBER: 88
SERIAL NUMBER: 46-2007

MFR/MODEL: CCF-BRILL, C-36

LENGTH: 30'9.5"(9 385 mm)
WIDTH: 7'11.75"(2 432 mm)
HEIGHT: 9'6"(2 896 mm)
WEIGHT: 15,085 lbs.(6 843 kg)

ENGINE: HALL-SCOTT 136, 6-CYL.
HORSEPOWER: 150(112 kW)
FUEL: GASOLINE
SEATING: 36

BUILT: 1946
DELIVERY: 5/1951
WITHDRAWN: 1962
DISPOSAL: 1/1965
REMARKS: FROM ST. JOHN, N.B., ex 100

BUS NUMBER: 89
SERIAL NUMBER: 46-2008

MFR/MODEL: CCF-BRILL, C-36

LENGTH: 30'9.5"(9 385 mm)
WIDTH: 7'11.75"(2 432 mm)
HEIGHT: 9'6"(2 896 mm)
WEIGHT: 15,085 lbs.(6 843 kg)

ENGINE: HALL-SCOTT 136, 6-CYL.
HORSEPOWER: 150(112 kW)
FUEL: GASOLINE
SEATING: 36

BUILT: 1946
DELIVERY: 5/1951
WITHDRAWN: 11/1966
DISPOSAL: 1967
REMARKS: FROM ST. JOHN, N.B., ex 102

BUS NUMBER: 90
SERIAL NUMBER: 46-2009

MFR/MODEL: CCF-BRILL, C-36

LENGTH: 30'9.5"(9 385 mm)
WIDTH: 7'11.75"(2 432 mm)
HEIGHT: 9'6"(2 896 mm)
WEIGHT: 15,085 lbs.(6 843 kg)

ENGINE: HALL-SCOTT 136, 6-CYL.
HORSEPOWER: 150(112 kW)
FUEL: GASOLINE
SEATING: 36

BUILT: 1946
DELIVERY: 5/1951
WITHDRAWN: 1963
DISPOSAL: 9/1964
REMARKS: FROM ST. JOHN, N.B., ex 104

BUS NUMBER: 91
SERIAL NUMBER: 46-2010

MFR/MODEL: CCF-BRILL, C-36

LENGTH: 30'9.5"(9 385 mm)
WIDTH: 7'11.75"(2 432 mm)
HEIGHT: 9'6"(2 896 mm)
WEIGHT: 15,085 lbs.(6 843 kg)

ENGINE: HALL-SCOTT 136, 6-CYL.
HORSEPOWER: 150(112 kW)
FUEL: GASOLINE
SEATING: 36

BUILT: 1946
DELIVERY: 5/1951
WITHDRAWN: 1964
DISPOSAL: 1/1965
REMARKS: FROM ST. JOHN, N.B., ex 106

BUS NUMBER: 92 SERIAL NUMBER: 46-2011

MFR/MODEL: CCF-BRILL, C-36

LENGTH: 30'9.5"(9 385 mm) ENGINE: HALL-SCOTT 136, 6-CYL.
WIDTH: 7'11.75"(2 432 mm) HORSEPOWER: 150(112 kW)
HEIGHT: 9'6"(2 896 mm) FUEL: GASOLINE
WEIGHT: 15,085 lbs.(6 843 kg) SEATING: 36

BUILT: 1946 WITHDRAWN: 1965
DELIVERY: 5/1951 DISPOSAL: 10/1965
REMARKS: FROM ST. JOHN, N.B., ex 108

BUS NUMBER: 93 SERIAL NUMBER: 46-2012

MFR/MODEL: CCF-BRILL, C-36

LENGTH: 30'9.5"(9 385 mm) ENGINE: HALL-SCOTT 136, 6-CYL.
WIDTH: 7'11.75"(2 432 mm) HORSEPOWER: 150(112 kW)
HEIGHT: 9'6"(2 896 mm) FUEL: GASOLINE
WEIGHT: 15,085 lbs.(6 843 kg) SEATING: 36

BUILT: 1946 WITHDRAWN: 1969
DELIVERY: 5/1951 DISPOSAL: 1969
REMARKS: FROM ST. JOHN, N.B., ex 110

BUS NUMBER: 94-99 SERIAL NUMBER: 1296-1301

MFR/MODEL: MACK MANUFACTURING, C-37DT

LENGTH: 35'(10 668 mm) ENGINE: MACK END-672, 6-CYL.
WIDTH: 8'1"(2 464 mm) HORSEPOWER: 57(42.5)
HEIGHT: 9'4"(2 845 mm) FUEL: DIESEL
WEIGHT: 16,200 lbs.(7 348 kg) SEATING: 37

ORDERED: 1951 WITHDRAWN: 1963-1964
DELIVERY: 11/1951 DISPOSAL: 1963-1965
REMARKS: SOLD OR SCRAPPED

BUS NUMBER: 401-408
SERIAL NUMBER: 1-8

MFR/MODEL: TWIN COACH, FLP-40

LENGTH: 40'(12 192 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 9'10"(2 997 mm)
WEIGHT: 17,000 lbs.(7 771 kg)

ENGINE: FTC 210
HORSEPOWER: 210(156.6 kW)
FUEL: PROPANE
SEATING: 52

ORDERED: 4/1951
DELIVERY: 5/1952
REMARKS: SCRAPPED

WITHDRAWN: 1963-1967
DISPOSAL: 1963-1967

BUS NUMBER: 409-418
SERIAL NUMBER: 1401-1410

MFR/MODEL: GMC TDH-5105

LENGTH: 39'9"(12 166 mm)
WIDTH: 8'4.4"(2 550 mm)
HEIGHT: 9'5.25"(1 133 mm)
WEIGHT: 19,350 lbs.(8 777 kg)

ENGINE: GM 6V-71
HORSEPOWER: 188(140 kW)
FUEL: DIESEL
SEATING: 52

ORDERED: 1955
DELIVERY: 9/1955
REMARKS:

WITHDRAWN: 1978
DISPOSAL: 1978

BUS NUMBER: 419-423
SERIAL NUMBER: 2504-2508

MFR/MODEL: GMC TDH-5105

LENGTH: 39'9"(12 166 mm)
WIDTH: 8'4.4"(2 550 mm)
HEIGHT: 9'5.25"(1 133 mm)
WEIGHT: 19,350 lbs.(8 777 kg)

ENGINE: GM 6V-71
HORSEPOWER: 188(140 kW)
FUEL: DIESEL
SEATING: 52

ORDERED: 1956
DELIVERY: 12/1956
REMARKS:

WITHDRAWN: 1978
DISPOSAL: 1978

BUS NUMBER: 424-431	SERIAL NUMBER: 3461-3468
MFR/MODEL: GMC TDH-5105	
LENGTH: 39'9"(12 166 mm)	ENGINE: GM 6V-71
WIDTH: 8'4.4"(2 550 mm)	HORSEPOWER: 188(140 kW)
HEIGHT: 9'5.25"(1 133 mm)	FUEL: DIESEL
WEIGHT: 19,350 lbs.(8 777 kg)	SEATING: 52
ORDERED: 5/1958	WITHDRAWN: 1978
DELIVERY: 12/1958	DISPOSAL: 1978
REMARKS:	

BUS NUMBER: 432	SERIAL NUMBER: 3469
MFR/MODEL: GMC TDH-5105	
LENGTH: 39'9"(12 166 mm)	ENGINE: GM 6V-71
WIDTH: 8'4.4"(2 550 mm)	HORSEPOWER: 188(140 kW)
HEIGHT: 9'5.25"(1 133 mm)	FUEL: DIESEL
WEIGHT: 19,350 lbs.(8 777 kg)	SEATING: 52
ORDERED: 5/1958	WITHDRAWN: 1978
DELIVERY: 12/1958	DISPOSAL: N/A
REMARKS: PRESERVED BY ET	

BUS NUMBER: 433	SERIAL NUMBER: 3470
MFR/MODEL: GMC TDH-5105	
LENGTH: 39'9"(12 166 mm)	ENGINE: GM 6V-71
WIDTH: 8'4.4"(2 550 mm)	HORSEPOWER: 188(140 kW)
HEIGHT: 9'5.25"(1 133 mm)	FUEL: DIESEL
WEIGHT: 19,350 lbs.(8 777 kg)	SEATING: 52
ORDERED: 5/1958	WITHDRAWN: 1978
DELIVERY: 12/1958	DISPOSAL: 1979
REMARKS:	

BUS NUMBER: 434-438 SERIAL NUMBER: 1564-1568

MFR/MODEL: GMC TDH-5301

LENGTH: 40'(12 192 mm)
WIDTH: 9'5.75"(2 889 mm)
HEIGHT: 9'10"(2 997 mm)
WEIGHT: 20,000 lbs.(9 072 kg)

ENGINE: GM 6V-71
HORSEPOWER: 188(140 kW)
FUEL: DIESEL
SEATING: 51

ORDERED: 1960
DELIVERY: 1960
REMARKS:

WITHDRAWN:
DISPOSAL:

BUS NUMBER: 801 SERIAL NUMBER:

MFR/MODEL: ONEIDA SCHOOL BUS

LENGTH:
WIDTH:
HEIGHT:
WEIGHT:

ENGINE:
HORSEPOWER:
FUEL: GASOLINE
SEATING: 48

ORDERED:
DELIVERY: 1961
REMARKS: TRADED-IN

WITHDRAWN: 1963
DISPOSAL: 1963

BUS NUMBER: 802 SERIAL NUMBER:

MFR/MODEL: ONEIDA SCHOOL BUS

LENGTH:
WIDTH:
HEIGHT:
WEIGHT:

ENGINE:
HORSEPOWER:
FUEL: GASOLINE
SEATING: 48

ORDERED:
DELIVERY: 1961
REMARKS: TRADED-IN

WITHDRAWN: 1963
DISPOSAL: 1963

BUS NUMBER: 803 SERIAL NUMBER:

MFR/MODEL: ONEIDA SCHOOL BUS

LENGTH:	ENGINE:
WIDTH:	HORSEPOWER:
HEIGHT:	FUEL: GASOLINE
WEIGHT:	SEATING: 48
ORDERED:	WITHDRAWN: 1966
DELIVERY: 1961	DISPOSAL: 8/1966
REMARKS: SOLD	

BUS NUMBER: 804 SERIAL NUMBER:

MFR/MODEL: CARPENTER SCHOOL BUS

LENGTH:	ENGINE: IHC
WIDTH:	HORSEPOWER:
HEIGHT:	FUEL: GASOLINE
WEIGHT:	SEATING: 54
ORDERED:	WITHDRAWN: 1966
DELIVERY: 1961	DISPOSAL: 8/1966
REMARKS: SOLD	

BUS NUMBER: 805 SERIAL NUMBER:

MFR/MODEL: CARPENTER SCHOOL BUS

LENGTH:	ENGINE: IHC
WIDTH:	HORSEPOWER:
HEIGHT:	FUEL: GASOLINE
WEIGHT:	SEATING: 54
ORDERED:	WITHDRAWN: 1968
DELIVERY: 1961	DISPOSAL: 2/1969
REMARKS: SOLD	

BUS NUMBER: 830-833 SERIAL NUMBER: 1658-1661

MFR/MODEL: BLUEBIRD SCHOOL BUS

LENGTH:
WIDTH:
HEIGHT:
WEIGHT:

ENGINE:
HORSEPOWER:
FUEL: GASOLINE
SEATING: 72

ORDERED:
DELIVERY: 3/1962
REMARKS:

WITHDRAWN:
DISPOSAL:

BUS NUMBER: 834 SERIAL NUMBER:

MFR/MODEL: SUPERIOR SCHOOL BUS

LENGTH:
WIDTH:
HEIGHT:
WEIGHT:

ENGINE:
HORSEPOWER:
FUEL: GASOLINE
SEATING: 72

ORDERED:
DELIVERY: 1962
REMARKS: SOLD

WITHDRAWN: 1969
DISPOSAL: 4/1969

BUS NUMBER: 835 SERIAL NUMBER:

MFR/MODEL: CARPENTER SCHOOL BUS

LENGTH: 34'(10 363 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'1"(3 073 mm)
WEIGHT:

ENGINE: IHC
HORSEPOWER:
FUEL: GASOLINE
SEATING: 72

ORDERED:
DELIVERY: 9/1962
REMARKS: SOLD

WITHDRAWN: 1970
DISPOSAL: 8/1970

BUS NUMBER: 836
SERIAL NUMBER:

MFR/MODEL: CARPENTER SCHOOL BUS

LENGTH: 34'(10 363 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'1"(3 073 mm)
WEIGHT:

ENGINE: IHC
HORSEPOWER:
FUEL: GASOLINE
SEATING: 72

ORDERED:
DELIVERY: 9/1962
REMARKS: SOLD

WITHDRAWN: 1970
DISPOSAL: 8/1970

BUS NUMBER: 837
SERIAL NUMBER:

MFR/MODEL: CARPENTER SCHOOL BUS

LENGTH: 34'(10 363 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'1"(3 073 mm)
WEIGHT:

ENGINE: IHC
HORSEPOWER:
FUEL: GASOLINE
SEATING: 72

ORDERED:
DELIVERY: 9/1962
REMARKS: SOLD

WITHDRAWN: 1970
DISPOSAL: 8/1970

BUS NUMBER: 838
SERIAL NUMBER: FD14668

MFR/MODEL: CARPENTER SCHOOL BUS

LENGTH: 34'(10 363 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'1"(3 073 mm)
WEIGHT:

ENGINE: IHC
HORSEPOWER:
FUEL: GASOLINE
SEATING: 72

ORDERED:
DELIVERY: 9/1962
REMARKS:

WITHDRAWN:
DISPOSAL:

BUS NUMBER: 839
SERIAL NUMBER: FD14665

MFR/MODEL: CARPENTER SCHOOL BUS

LENGTH: 34'(10 363 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'1"(3 073 mm)
WEIGHT:

ENGINE: IHC
HORSEPOWER:
FUEL: GASOLINE
SEATING: 72

ORDERED:
DELIVERY: 9/1962
REMARKS:

WITHDRAWN:
DISPOSAL:

BUS NUMBER: 840
SERIAL NUMBER: FD14701

MFR/MODEL: CARPENTER SCHOOL BUS

LENGTH: 34'(10 363 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'1"(3 073 mm)
WEIGHT:

ENGINE: IHC
HORSEPOWER:
FUEL: GASOLINE
SEATING: 72

ORDERED:
DELIVERY: 9/1962
REMARKS:

WITHDRAWN: 1975
DISPOSAL: 1975

BUS NUMBER: 841
SERIAL NUMBER: FD14790

MFR/MODEL: CARPENTER SCHOOL BUS

LENGTH: 34'(10 363 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'1"(3 073 mm)
WEIGHT:

ENGINE: IHC
HORSEPOWER:
FUEL: GASOLINE
SEATING: 72

ORDERED:
DELIVERY: 9/1962
REMARKS:

WITHDRAWN: 1975
DISPOSAL: 1975

BUS NUMBER: 842
SERIAL NUMBER: FD14795

MFR/MODEL: CARPENTER SCHOOL BUS

LENGTH: 34'(10 363 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'1"(3 073 mm)
WEIGHT:
ENGINE: IHC
HORSEPOWER:
FUEL: GASOLINE
SEATING: 72

ORDERED:
DELIVERY: 9/1962
REMARKS:
WITHDRAWN: 1975
DISPOSAL: 1975

BUS NUMBER: 843
SERIAL NUMBER: FD14784

MFR/MODEL: CARPENTER SCHOOL BUS

LENGTH: 34'(10 363 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'1"(3 073 mm)
WEIGHT:
ENGINE: IHC
HORSEPOWER:
FUEL: GASOLINE
SEATING: 72

ORDERED:
DELIVERY: 9/1962
REMARKS:
WITHDRAWN: 1975
DISPOSAL: 1975

BUS NUMBER: 844
SERIAL NUMBER: FD14801

MFR/MODEL: CARPENTER SCHOOL BUS

LENGTH: 34'(10 363 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'1"(3 073 mm)
WEIGHT:
ENGINE: IHC
HORSEPOWER:
FUEL: GASOLINE
SEATING: 72

ORDERED:
DELIVERY: 9/1962
REMARKS:
WITHDRAWN: 1975
DISPOSAL: 1975

BUS NUMBER: 439-443 SERIAL NUMBER: C080-C084

MFR/MODEL: GMC TDH-5301

LENGTH: 40'(12 192 mm) ENGINE: GM 6V-71
WIDTH: 9'5.75"(2 889 mm) HORSEPOWER: 188(140 kW)
HEIGHT: 9'10"(2 997 mm) FUEL: DIESEL
WEIGHT: 20,000 lbs.(9 072 kg) SEATING: 51

ORDERED: WITHDRAWN:
DELIVERY: 1962 DISPOSAL:
REMARKS:

BUS NUMBER: 501 SERIAL NUMBER:

MFR/MODEL: TWIN COACH 41S

LENGTH: 32'10"(10 008 mm) ENGINE: FTC-180
WIDTH: 8'(2 438 mm) HORSEPOWER: 180(134 kW)
HEIGHT: 9'(2 743 mm) FUEL: GASOLINE
WEIGHT: 24,000 lbs.(10 886 kg SEATING: 41

BUILT: 1947 WITHDRAWN: 1968
DELIVERY: 11/1962 DISPOSAL: 4/1969
REMARKS: EX WINNIPEG 851; RENUMBERED 1, 9/1966

BUS NUMBER: 502 SERIAL NUMBER:

MFR/MODEL: TWIN COACH 41S

LENGTH: 32'10"(10 008 mm) ENGINE: FTC-180
WIDTH: 8'(2 438 mm) HORSEPOWER: 180(134 kW)
HEIGHT: 9'(2 743 mm) FUEL: GASOLINE
WEIGHT: 24,000 lbs.(10 886 kg SEATING: 41

BUILT: 1947 WITHDRAWN: 1968
DELIVERY: 11/1962 DISPOSAL:
REMARKS: EX WINNIPEG 853, RENUMBERED 2, 9/1966

BUS NUMBER: 503 SERIAL NUMBER:

MFR/MODEL: TWIN COACH 41S

LENGTH: 32'10"(10 008 mm) ENGINE: FTC-180
WIDTH: 8'(2 438 mm) HORSEPOWER: 180(134 kW)
HEIGHT: 9'(2 743 mm) FUEL: GASOLINE
WEIGHT: 24,000 lbs.(10 886 kg SEATING: 41

BUILT: 1947 WITHDRAWN: 1968
DELIVERY: 11/1962 DISPOSAL: 11/1968
REMARKS: EX WINNIPEG 855, RENUMBERED 3, 9/1966

BUS NUMBER: 504 SERIAL NUMBER:

MFR/MODEL: TWIN COACH 41S

LENGTH: 32'10"(10 008 mm) ENGINE: FTC-180
WIDTH: 8'(2 438 mm) HORSEPOWER: 180(134 kW)
HEIGHT: 9'(2 743 mm) FUEL: GASOLINE
WEIGHT: 24,000 lbs.(10 886 kg SEATING: 41

BUILT: 1947 WITHDRAWN: 1968
DELIVERY: 11/1962 DISPOSAL: 1969
REMARKS: EX WINNIPEG 857, RENUMBERED 4, 9/1966

BUS NUMBER: 505 SERIAL NUMBER:

MFR/MODEL: TWIN COACH 41S

LENGTH: 32'10"(10 008 mm) ENGINE: FTC-180
WIDTH: 8'(2 438 mm) HORSEPOWER: 180(134 kW)
HEIGHT: 9'(2 743 mm) FUEL: GASOLINE
WEIGHT: 24,000 lbs.(10 886 kg SEATING: 41

BUILT: 1947 WITHDRAWN: 1968
DELIVERY: 11/1962 DISPOSAL: 1969
REMARKS: EX WINNIPEG 859, RENUMBERED 5, 9/1966

BUS NUMBER: 506
SERIAL NUMBER:

MFR/MODEL: TWIN COACH 41S

LENGTH: 32'10"(10 008 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 9'(2 743 mm)
WEIGHT: 24,000 lbs.(10 886 kg
ENGINE: FTC-180
HORSEPOWER: 180(134 kW)
FUEL: GASOLINE
SEATING: 41

BUILT: 1947
DELIVERY: 11/1962
WITHDRAWN: 1968
DISPOSAL: 1969
REMARKS: EX WINNIPEG 861, RENUMBERED 6, 9/1966

BUS NUMBER: 507
SERIAL NUMBER:

MFR/MODEL: TWIN COACH 41S

LENGTH: 32'10"(10 008 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 9'(2 743 mm)
WEIGHT: 24,000 lbs.(10 886 kg
ENGINE: FTC-180
HORSEPOWER: 180(134 kW)
FUEL: GASOLINE
SEATING: 41

BUILT: 1947
DELIVERY: 11/1962
WITHDRAWN: 1968
DISPOSAL: 1969
REMARKS: EX WINNIPEG 863, RENUMBERED 7, 9/1966

BUS NUMBER: 508
SERIAL NUMBER:

MFR/MODEL: TWIN COACH 41S

LENGTH: 32'10"(10 008 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 9'(2 743 mm)
WEIGHT: 24,000 lbs.(10 886 kg
ENGINE: FTC-180
HORSEPOWER: 180(134 kW)
FUEL: GASOLINE
SEATING: 41

BUILT: 1947
DELIVERY: 11/1962
WITHDRAWN: 1968
DISPOSAL: 12/1975
REMARKS: EX WINNIPEG 865, RENUMBERED 8, 9/1966

BUS NUMBER: 509 SERIAL NUMBER:

MFR/MODEL: TWIN COACH 41S

LENGTH: 32'10"(10 008 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 9'(2 743 mm)
WEIGHT: 24,000 lbs.(10 886 kg

ENGINE: FTC-180
HORSEPOWER: 180(134 kW)
FUEL: GASOLINE
SEATING: 41

BUILT: 1947
DELIVERY: 11/1962

WITHDRAWN: 1966
DISPOSAL: 11/1966

REMARKS: EX WINNIPEG 867; RENUMBERED 9, 9/1966

BUS NUMBER: 510 SERIAL NUMBER:

MFR/MODEL: TWIN COACH 41S

LENGTH: 32'10"(10 008 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 9'(2 743 mm)
WEIGHT: 24,000 lbs.(10 886 kg

ENGINE: FTC-180
HORSEPOWER: 180(134 kW)
FUEL: GASOLINE
SEATING: 41

BUILT: 1947
DELIVERY: 11/1962

WITHDRAWN: 1966
DISPOSAL: 7/1966

REMARKS: EX WINNIPEG 869

BUS NUMBER: 511 SERIAL NUMBER:

MFR/MODEL: TWIN COACH 38S

LENGTH: 31'(9 449 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 9'(2 743 mm)
WEIGHT: 24,000 lbs.(10 886 kg

ENGINE: FTC-180
HORSEPOWER: 180(134 kW)
FUEL: GASOLINE
SEATING: 38

BUILT: 1946
DELIVERY: 11/1962

WITHDRAWN: 1966
DISPOSAL: 5/1966

REMARKS: EX WINNIPEG 813

BUS NUMBER: 512
SERIAL NUMBER:

MFR/MODEL: TWIN COACH 38S

LENGTH: 31'(9 449 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 9'(2 743 mm)
WEIGHT: 24,000 lbs.(10 886 kg

ENGINE: FTC-180
HORSEPOWER: 180(134 kW)
FUEL: GASOLINE
SEATING: 38

BUILT: 1946
DELIVERY: 11/1962
WITHDRAWN: 1967
DISPOSAL: 4/1967
REMARKS: EX WINNIPEG 815; RENUMBERED 11, 9/1966

BUS NUMBER: 513
SERIAL NUMBER:

MFR/MODEL: TWIN COACH 38S

LENGTH: 31'(9 449 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 9'(2 743 mm)
WEIGHT: 24,000 lbs.(10 886 kg

ENGINE: FTC-180
HORSEPOWER: 180(134 kW)
FUEL: GASOLINE
SEATING: 38

BUILT: 1946
DELIVERY: 11/1962
WITHDRAWN: 1967
DISPOSAL: 1/1970
REMARKS: EX WINNIPEG 817; RENUMBERED 12, 9/1966

BUS NUMBER: 514
SERIAL NUMBER:

MFR/MODEL: TWIN COACH 38S

LENGTH: 31'(9 449 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 9'(2 743 mm)
WEIGHT: 24,000 lbs.(10 886 kg

ENGINE: FTC-180
HORSEPOWER: 180(134 kW)
FUEL: GASOLINE
SEATING: 38

BUILT: 1946
DELIVERY: 11/1962
WITHDRAWN: 1966
DISPOSAL: 5/1966
REMARKS: EX WINNIPEG 819

BUS NUMBER: 515
SERIAL NUMBER: 913C

MFR/MODEL: TWIN COACH 38S

LENGTH: 31'(9 449 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 9'(2 743 mm)
WEIGHT: 24,000 lbs.(10 886 kg

ENGINE: FTC-180
HORSEPOWER: 180(134 kW)
FUEL: GASOLINE
SEATING: 38

BUILT: 1948
DELIVERY: 11/1962
REMARKS: EX WINNIPEG 821

WITHDRAWN: 1965
DISPOSAL: 2/1966

BUS NUMBER: 516
SERIAL NUMBER: 914C

MFR/MODEL: TWIN COACH 38S

LENGTH: 31'(9 449 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 9'(2 743 mm)
WEIGHT: 24,000 lbs.(10 886 kg

ENGINE: FTC-180
HORSEPOWER: 180(134 kW)
FUEL: GASOLINE
SEATING: 38

BUILT: 1948
DELIVERY: 11/1962

WITHDRAWN: 1967
DISPOSAL: 9/1969

REMARKS: EX WINNIPEG 823; RENUMBERED 13, 9/1966

BUS NUMBER: 517
SERIAL NUMBER: 915C

MFR/MODEL: TWIN COACH 38S

LENGTH: 31'(9 449 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 9'(2 743 mm)
WEIGHT: 24,000 lbs.(10 886 kg

ENGINE: FTC-180
HORSEPOWER: 180(134 kW)
FUEL: GASOLINE
SEATING: 38

BUILT: 1948
DELIVERY: 11/1962
REMARKS: EX WINNIPEG 825

WITHDRAWN: 1965
DISPOSAL: 2/1966

BUS NUMBER: 518 SERIAL NUMBER: 916C

MFR/MODEL: TWIN COACH 38S

LENGTH: 31'(9 449 mm) ENGINE: FTC-180
WIDTH: 8'(2 438 mm) HORSEPOWER: 180(134 kW)
HEIGHT: 9'(2 743 mm) FUEL: GASOLINE
WEIGHT: 24,000 lbs.(10 886 kg SEATING: 38

BUILT: 1948 WITHDRAWN: 1965
DELIVERY: 11/1962 DISPOSAL: 2/1966
REMARKS: EX WINNIPEG 827

BUS NUMBER: 519 SERIAL NUMBER: 917C

MFR/MODEL: TWIN COACH 38S

LENGTH: 31'(9 449 mm) ENGINE: FTC-180
WIDTH: 8'(2 438 mm) HORSEPOWER: 180(134 kW)
HEIGHT: 9'(2 743 mm) FUEL: GASOLINE
WEIGHT: 24,000 lbs.(10 886 kg SEATING: 38

BUILT: 1948 WITHDRAWN: 1967
DELIVERY: 11/1962 DISPOSAL: 4/1967
REMARKS: EX WINNIPEG 829; RENUMBERED 14, 9/1966

BUS NUMBER: 520 SERIAL NUMBER: 918C

MFR/MODEL: TWIN COACH 38S

LENGTH: 31'(9 449 mm) ENGINE: FTC-180
WIDTH: 8'(2 438 mm) HORSEPOWER: 180(134 kW)
HEIGHT: 9'(2 743 mm) FUEL: GASOLINE
WEIGHT: 24,000 lbs.(10 886 kg SEATING: 38

BUILT: 1948 WITHDRAWN: 1966
DELIVERY: 11/1962 DISPOSAL: 1966
REMARKS: EX WINNIPEG 831

BUS NUMBER: 444 SERIAL NUMBER: C134

MFR/MODEL: GMC TDH-5301

LENGTH: 40'(12 192 mm) ENGINE: GM 6V-71
WIDTH: 9'5.75"(2 889 mm) HORSEPOWER: 188(140 kW)
HEIGHT: 9'10"(2 997 mm) FUEL: DIESEL
WEIGHT: 20,000 lbs.(9 072 kg) SEATING: 51

ORDERED: 1962 WITHDRAWN:
DELIVERY: 1/1963 DISPOSAL:
REMARKS:

BUS NUMBER: (445) SERIAL NUMBER: C135

MFR/MODEL: GMC TDH-5301

LENGTH: 40'(12 192 mm) ENGINE: GM 6V-71
WIDTH: 9'5.75"(2 889 mm) HORSEPOWER: 188(140 kW)
HEIGHT: 9'10"(2 997 mm) FUEL: DIESEL
WEIGHT: 20,000 lbs.(9 072 kg) SEATING: 51

ORDERED: 1962 WITHDRAWN: 1962
DELIVERY: 1/1963 DISPOSAL: 1962
REMARKS: ARRIVED DAMAGED, SOLD TO CALGARY, NOW 551

BUS NUMBER: 446-448 SERIAL NUMBER: C136-C138

MFR/MODEL: GMC TDH-5301

LENGTH: 40'(12 192 mm) ENGINE: GM 6V-71
WIDTH: 9'5.75"(2 889 mm) HORSEPOWER: 188(140 kW)
HEIGHT: 9'10"(2 997 mm) FUEL: DIESEL
WEIGHT: 20,000 lbs.(9 072 kg) SEATING: 51

ORDERED: 1962 WITHDRAWN:
DELIVERY: 1-2/1963 DISPOSAL:
REMARKS:

BUS NUMBER: 449-473 SERIAL NUMBER: C142-C166

MFR/MODEL: GMC TDH-5301

LENGTH: 40'(12 192 mm) ENGINE: GM 6V-71
WIDTH: 9'5.75"(2 889 mm) HORSEPOWER: 188(140 kW)
HEIGHT: 9'10"(2 997 mm) FUEL: DIESEL
WEIGHT: 20,000 lbs.(9 072 kg) SEATING: 51

ORDERED: 1962 WITHDRAWN:
DELIVERY: 2/1963 DISPOSAL:
REMARKS:

BUS NUMBER: 845 SERIAL NUMBER: FD40654

MFR/MODEL: CARPENTER SCHOOL BUS

LENGTH: 34'(10 363 mm) ENGINE: IHC
WIDTH: 8'(2 438 mm) HORSEPOWER:
HEIGHT: 10'1"(3 073 mm) FUEL: GASOLINE
WEIGHT: SEATING: 72

ORDERED: 1963 WITHDRAWN:
DELIVERY: 10/1963 DISPOSAL:
REMARKS:

BUS NUMBER: 846 SERIAL NUMBER: FD41072

MFR/MODEL: CARPENTER SCHOOL BUS

LENGTH: 34'(10 363 mm) ENGINE: IHC
WIDTH: 8'(2 438 mm) HORSEPOWER:
HEIGHT: 10'1"(3 073 mm) FUEL: GASOLINE
WEIGHT: SEATING: 72

ORDERED: 1963 WITHDRAWN:
DELIVERY: 10/1963 DISPOSAL:
REMARKS:

BUS NUMBER: 847 SERIAL NUMBER: FD41092

MFR/MODEL: CARPENTER SCHOOL BUS

LENGTH: 34'(10 363 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'1"(3 073 mm)
WEIGHT:

ENGINE: IHC
HORSEPOWER:
FUEL: GASOLINE
SEATING: 72

ORDERED: 1963
DELIVERY: 10/1963
REMARKS:

WITHDRAWN:
DISPOSAL:

BUS NUMBER: 848 SERIAL NUMBER: FD40539

MFR/MODEL: CARPENTER SCHOOL BUS

LENGTH: 34'(10 363 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'1"(3 073 mm)
WEIGHT:

ENGINE: IHC
HORSEPOWER:
FUEL: GASOLINE
SEATING: 72

ORDERED: 1963
DELIVERY: 10/1963
REMARKS:

WITHDRAWN:
DISPOSAL:

BUS NUMBER: 849 SERIAL NUMBER: FD40518

MFR/MODEL: CARPENTER SCHOOL BUS

LENGTH: 34'(10 363 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'1"(3 073 mm)
WEIGHT:

ENGINE: IHC
HORSEPOWER:
FUEL: GASOLINE
SEATING: 72

ORDERED: 1963
DELIVERY: 10/1963
REMARKS:

WITHDRAWN:
DISPOSAL:

BUS NUMBER: 850-853
SERIAL NUMBER: CBB2031-CBB2034

MFR/MODEL: BLUEBIRD SCHOOL BUS

LENGTH: 34'(10 363 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'1"(3 073 mm)
WEIGHT:

ENGINE: CHEVROLET V-8 348A
HORSEPOWER:
FUEL: GASOLINE
SEATING: 67

ORDERED:
DELIVERY: 9&10/1963
REMARKS: SOLD

WITHDRAWN: 1975
DISPOSAL: 1/1976

BUS NUMBER: 854
SERIAL NUMBER: CBB2035

MFR/MODEL: BLUEBIRD TRANSIT BUS

LENGTH: 34'(10 363 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'1"(3 073 mm)
WEIGHT:

ENGINE: CHEVROLET V-8 348A
HORSEPOWER:
FUEL: GASOLINE
SEATING: 67

ORDERED:
DELIVERY: 10/1963
REMARKS:

WITHDRAWN: 1971
DISPOSAL: 11/1971

BUS NUMBER: 474-493
SERIAL NUMBER: C170-C189

MFR/MODEL: GMC TDH5303

LENGTH: 40'4"(12 294 mm)
WIDTH: 9'5.75"(2 889 mm)
HEIGHT: 9'10"(2 997 mm)
WEIGHT: 21,500 lbs.(9 752 kg)

ENGINE: GM 6V-71
HORSEPOWER: 188(140 kW)
FUEL: DIESEL
SEATING: 52

ORDERED: 1963
DELIVERY: 1964
REMARKS:

WITHDRAWN:
DISPOSAL:

BUS NUMBER: 10/2nd
SERIAL NUMBER: 00092

MFR/MODEL: MITSUBISHI-FUSO, MAR750L

LENGTH: 39'11.5"(12 179 mm)
WIDTH: 8'2"(2 490 mm)
HEIGHT: 10'2"(3 100 mm)
WEIGHT: 22,920 lbs.(10 420 kg

ENGINE: MITSUBISHI 8DB20A
HORSEPOWER: 233(174 kW)
FUEL: DIESEL
SEATING: 51

ORDERED: 1963
DELIVERY: 3/1964
WITHDRAWN: 6/1971
DISPOSAL: 1971
REMARKS: RENUMBERED 600, 1968; SOLD

BUS NUMBER: 601
SERIAL NUMBER: UD21930

MFR/MODEL: NISSAN 6LRA110-K2

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'2"(2 490 mm)
HEIGHT: 10'3"(3 124 mm)
WEIGHT: 21,000 lbs.(9 526 kg)

ENGINE: NISSAN UD6
HORSEPOWER: 236(176 kW)
FUEL: DIESEL
SEATING: 48

ORDERED: 4/1964
DELIVERY: 12/1964
REMARKS: PROTOTYPE

WITHDRAWN: 1973
DISPOSAL: 1973

BUS NUMBER: 602
SERIAL NUMBER: UD21931

MFR/MODEL: NISSAN 6LRA110-K2

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'2"(2 490 mm)
HEIGHT: 10'3"(3 124 mm)
WEIGHT: 21,000 lbs.(9 526 kg)

ENGINE: NISSAN UD6
HORSEPOWER: 236(176 kW)
FUEL: DIESEL
SEATING: 48

ORDERED: 4/1964
DELIVERY: 12/1964
REMARKS: PROTOTYPE

WITHDRAWN: 1973
DISPOSAL: 1973

BUS NUMBER: 603
SERIAL NUMBER: UD21932

MFR/MODEL: NISSAN 6LRA110-K2

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'2"(2 490 mm)
HEIGHT: 10'3"(3 124 mm)
WEIGHT: 21,000 lbs.(9 526 kg)
ENGINE: NISSAN UD6
HORSEPOWER: 236(176 kW)
FUEL: DIESEL
SEATING: 48

ORDERED: 4/1964
DELIVERY: 12/1964
REMARKS: PROTOTYPE
WITHDRAWN: 1973
DISPOSAL: 1973

BUS NUMBER: 855-866
SERIAL NUMBER: CBB2070-CBB2081

MFR/MODEL: BLUEBIRD TRANSIT BUS

LENGTH: 35'3"(11 557 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT: 16,400 lbs.(7 439 kg)
ENGINE: CHEVROLET V-8 360
HORSEPOWER: 180(134 kW)
FUEL: GASOLINE
SEATING: 45

ORDERED: 4/1964
DELIVERY: 9/1964
REMARKS:
WITHDRAWN: 1977
DISPOSAL: 1977

BUS NUMBER: 867-868
SERIAL NUMBER: CBB2087-CBB2088

MFR/MODEL: BLUEBIRD TRANSIT BUS

LENGTH: 35'3"(11 557 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'3"(3 099 mm)
WEIGHT: 16,400 lbs.(7 439 kg)
ENGINE: CHEVROLET V-8 360
HORSEPOWER: 180(134 kW)
FUEL: GASOLINE
SEATING: 45

ORDERED: 4/1964
DELIVERY: 9/1964
REMARKS:
WITHDRAWN: 1977
DISPOSAL: 1977

BUS NUMBER: 869
SERIAL NUMBER: CBB2083

MFR/MODEL: BLUEBIRD SCHOOL BUS

LENGTH: 35'3"(11 557 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT:

ENGINE: CHEVROLET V-8 348A
HORSEPOWER:
FUEL: GASOLINE
SEATING: 67

ORDERED: 4/1964
DELIVERY: 9/1964
REMARKS: SOLD

WITHDRAWN: 1975
DISPOSAL: 1976

BUS NUMBER: 870
SERIAL NUMBER: CBB2089

MFR/MODEL: BLUEBIRD SCHOOL BUS

LENGTH: 35'3"(11 557 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT:

ENGINE: CHEVROLET V-8 348A
HORSEPOWER:
FUEL: GASOLINE
SEATING: 67

ORDERED:
DELIVERY: 9/1964
REMARKS: SOLD

WITHDRAWN: 1975
DISPOSAL: 1976

BUS NUMBER: 871
SERIAL NUMBER: CBB2084

MFR/MODEL: BLUEBIRD SCHOOL BUS

LENGTH: 35'3"(11 557 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT:

ENGINE: CHEVROLET V-8 348A
HORSEPOWER:
FUEL: GASOLINE
SEATING: 67

ORDERED:
DELIVERY: 9/1964
REMARKS: SOLD

WITHDRAWN: 1975
DISPOSAL: 1976

BUS NUMBER: 872
SERIAL NUMBER: CBB2085

MFR/MODEL: BLUEBIRD SCHOOL BUS

LENGTH: 35'3"(11 557 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT:
ENGINE: CHEVROLET V-8 348A
HORSEPOWER:
FUEL: GASOLINE
SEATING: 67

ORDERED:
DELIVERY: 9/1964
REMARKS: SOLD
WITHDRAWN: 1975
DISPOSAL: 1976

BUS NUMBER: 873
SERIAL NUMBER: CBB2082

MFR/MODEL: BLUEBIRD SCHOOL BUS

LENGTH: 35'3"(11 557 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT:
ENGINE: CHEVROLET V-8 348A
HORSEPOWER:
FUEL: GASOLINE
SEATING: 67

ORDERED:
DELIVERY: 9/1964
REMARKS: SOLD
WITHDRAWN: 1975
DISPOSAL: 1976

BUS NUMBER: 874
SERIAL NUMBER: CBB2086

MFR/MODEL: BLUEBIRD SCHOOL BUS

LENGTH: 35'3"(11 557 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT:
ENGINE: CHEVROLET V-8 348A
HORSEPOWER:
FUEL: GASOLINE
SEATING: 67

ORDERED:
DELIVERY: 9/1964
REMARKS: SOLD
WITHDRAWN: 1975
DISPOSAL: 1976

BUS NUMBER: 604-613
SERIAL NUMBER: UD0029-UD0038

MFR/MODEL: NISSAN 6RLA110-K2

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'2"(2 490 mm)
HEIGHT: 10'3"(3 124 mm)
WEIGHT: 21,000 lbs.(9 571 kg)

ENGINE: NISSAN UD6
HORSEPOWER: 236(176 kW)
FUEL: DIESEL
SEATING: 46

ORDERED: 12/1964
DELIVERY: 2-3/1966
REMARKS:

WITHDRAWN: 1974
DISPOSAL: 1974-1975

BUS NUMBER: 701
SERIAL NUMBER: 36004

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT: 21,100 lbs.(9 571 kg)

ENGINE: CUMMINS V6-200
HORSEPOWER: 192(143 kW)
FUEL: DIESEL
SEATING: 44

ORDERED: 9/1964
DELIVERY: 4/1966
REMARKS: PROTOTYPE

WITHDRAWN: 1973
DISPOSAL: 1973

BUS NUMBER: 702
SERIAL NUMBER: 36008

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT: 21,100 lbs.(9 571 kg)

ENGINE: CUMMINS V6-200
HORSEPOWER: 192(143 kW)
FUEL: DIESEL
SEATING: 44

ORDERED: 9/1964
DELIVERY: 8/1966
REMARKS: PROTOTYPE

WITHDRAWN: 1973
DISPOSAL: 6/1975

BUS NUMBER: 703
SERIAL NUMBER: 36006

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT: 21,100 lbs.(9 571 kg)
ENGINE: CUMMINS V6-200
HORSEPOWER: 192(143 kW)
FUEL: DIESEL
SEATING: 44

ORDERED: 9/1964
DELIVERY: 9/1966
REMARKS: PROTOTYPE
WITHDRAWN: 1973
DISPOSAL: 2/1976

BUS NUMBER: 704
SERIAL NUMBER: 36026

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT: 21,100 lbs.(9 571 kg)
ENGINE: CUMMINS V6-200
HORSEPOWER: 192(143 kW)
FUEL: DIESEL
SEATING: 44

ORDERED: 12/1964
DELIVERY: 2/1967
REMARKS:
WITHDRAWN: 8/1974
DISPOSAL: 6/1975

BUS NUMBER: 705
SERIAL NUMBER: 36027

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT: 21,100 lbs.(9 571 kg)
ENGINE: CUMMINS V6-200
HORSEPOWER: 192(143 kW)
FUEL: DIESEL
SEATING: 44

ORDERED: 12/1964
DELIVERY: 2/1967
REMARKS:
WITHDRAWN: 8/1974
DISPOSAL: 6/1975

BUS NUMBER: 706 SERIAL NUMBER: 36028

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm) ENGINE: CUMMINS V6-200
WIDTH: 8'2"(2 489 mm) HORSEPOWER: 192(143 kW)
HEIGHT: 10'2"(3 099 mm) FUEL: DIESEL
WEIGHT: 21,100 lbs.(9 571 kg) SEATING: 44

ORDERED: 12/1964 WITHDRAWN: 1974
DELIVERY: 8/1967 DISPOSAL: 8/1975
REMARKS:

BUS NUMBER: 707 SERIAL NUMBER: 36029

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm) ENGINE: CUMMINS V6-200
WIDTH: 8'2"(2 489 mm) HORSEPOWER: 192(143 kW)
HEIGHT: 10'2"(3 099 mm) FUEL: DIESEL
WEIGHT: 21,100 lbs.(9 571 kg) SEATING: 44

ORDERED: 12/1964 WITHDRAWN: 1974
DELIVERY: 10/1967 DISPOSAL: N/A
REMARKS: NOW INFOBUS, PRESERVED BY ETS

BUS NUMBER: 708 SERIAL NUMBER: 36030

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm) ENGINE: CUMMINS V6-200
WIDTH: 8'2"(2 489 mm) HORSEPOWER: 192(143 kW)
HEIGHT: 10'2"(3 099 mm) FUEL: DIESEL
WEIGHT: 21,100 lbs.(9 571 kg) SEATING: 44

ORDERED: 12/1964 WITHDRAWN: 1974
DELIVERY: 2/1967 DISPOSAL: 2/1976
REMARKS:

BUS NUMBER: 709 SERIAL NUMBER: 36031

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT: 21,100 lbs.(9 571 kg)

ENGINE: CUMMINS V6-200
HORSEPOWER: 192(143 kW)
FUEL: DIESEL
SEATING: 44

ORDERED: 12/1964
DELIVERY: 7/1967
REMARKS:

WITHDRAWN: 1974
DISPOSAL: 2/1976

BUS NUMBER: 710 SERIAL NUMBER: 36032

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT: 21,100 lbs.(9 571 kg)

ENGINE: CUMMINS V6-200
HORSEPOWER: 192(143 kW)
FUEL: DIESEL
SEATING: 44

ORDERED: 12/1964
DELIVERY: 3/1967
REMARKS:

WITHDRAWN: 1974
DISPOSAL: 2/1976

BUS NUMBER: 711 SERIAL NUMBER: 36033

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT: 21,100 lbs.(9 571 kg)

ENGINE: CUMMINS V6-200
HORSEPOWER: 192(143 kW)
FUEL: DIESEL
SEATING: 44

ORDERED: 12/1964
DELIVERY: 9/1967
REMARKS:

WITHDRAWN: 8/1974
DISPOSAL: 6/1975

BUS NUMBER: 712
SERIAL NUMBER: 36034

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT: 21,100 lbs.(9 571 kg)

ENGINE: CUMMINS V6-200
HORSEPOWER: 192(143 kW)
FUEL: DIESEL
SEATING: 44

ORDERED: 12/1964
DELIVERY: 11/1967
REMARKS:

WITHDRAWN: 1974
DISPOSAL:

BUS NUMBER: 713
SERIAL NUMBER: 36035

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT: 21,100 lbs.(9 571 kg)

ENGINE: CUMMINS V6-200
HORSEPOWER: 192(143 kW)
FUEL: DIESEL
SEATING: 44

ORDERED: 12/1964
DELIVERY: 8/1967
REMARKS:

WITHDRAWN: 1974
DISPOSAL: 2/1976

BUS NUMBER: 714
SERIAL NUMBER: 36036

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT: 21,100 lbs.(9 571 kg)

ENGINE: CUMMINS V6-200
HORSEPOWER: 192(143 kW)
FUEL: DIESEL
SEATING: 44

ORDERED: 12/1964
DELIVERY: 8/1967
REMARKS:

WITHDRAWN: 1974
DISPOSAL: 2/1976

BUS NUMBER: 715 SERIAL NUMBER: 36037

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)	ENGINE: CUMMINS V6-200
WIDTH: 8'2"(2 489 mm)	HORSEPOWER: 192(143 kW)
HEIGHT: 10'2"(3 099 mm)	FUEL: DIESEL
WEIGHT: 21,100 lbs.(9 571 kg)	SEATING: 44

ORDERED: 12/1964	WITHDRAWN: 1974
DELIVERY: 4/1967	DISPOSAL: 2/1976
REMARKS:	

BUS NUMBER: 716 SERIAL NUMBER: 36038

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)	ENGINE: CUMMINS V6-200
WIDTH: 8'2"(2 489 mm)	HORSEPOWER: 192(143 kW)
HEIGHT: 10'2"(3 099 mm)	FUEL: DIESEL
WEIGHT: 21,100 lbs.(9 571 kg)	SEATING: 44

ORDERED: 12/1964	WITHDRAWN: 1974
DELIVERY: 1/1968	DISPOSAL: 2/1976
REMARKS:	

BUS NUMBER: 717 SERIAL NUMBER: 36039

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)	ENGINE: CUMMINS V6-200
WIDTH: 8'2"(2 489 mm)	HORSEPOWER: 192(143 kW)
HEIGHT: 10'2"(3 099 mm)	FUEL: DIESEL
WEIGHT: 21,100 lbs.(9 571 kg)	SEATING: 44

ORDERED: 12/1964	WITHDRAWN: 1974
DELIVERY: 9/1967	DISPOSAL: 8/1975
REMARKS:	

BUS NUMBER: 718 SERIAL NUMBER: 36040

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT: 21,100 lbs.(9 571 kg)

ENGINE: CUMMINS V6-200
HORSEPOWER: 192(143 kW)
FUEL: DIESEL
SEATING: 44

ORDERED: 12/1964
DELIVERY: 8/1967
REMARKS:

WITHDRAWN: 1973
DISPOSAL: 1973

BUS NUMBER: 719 SERIAL NUMBER: 36041

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT: 21,100 lbs.(9 571 kg)

ENGINE: CUMMINS V6-200
HORSEPOWER: 192(143 kW)
FUEL: DIESEL
SEATING: 44

ORDERED: 12/1964
DELIVERY: 10/1968
REMARKS:

WITHDRAWN: 1974
DISPOSAL: 2/1976

BUS NUMBER: 720 SERIAL NUMBER: 36042

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT: 21,100 lbs.(9 571 kg)

ENGINE: CUMMINS V6-200
HORSEPOWER: 192(143 kW)
FUEL: DIESEL
SEATING: 44

ORDERED: 12/1964
DELIVERY: 9/1967
REMARKS:

WITHDRAWN: 1974
DISPOSAL: 2/1976

BUS NUMBER: 721 SERIAL NUMBER: 36043

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT: 21,100 lbs.(9 571 kg)

ENGINE: CUMMINS V6-200
HORSEPOWER: 192(143 kW)
FUEL: DIESEL
SEATING: 44

ORDERED: 12/1964
DELIVERY: 1/1968
REMARKS:

WITHDRAWN: 1974
DISPOSAL: 2/1976

BUS NUMBER: 722 SERIAL NUMBER: 36044

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT: 21,100 lbs.(9 571 kg)

ENGINE: CUMMINS V6-200
HORSEPOWER: 192(143 kW)
FUEL: DIESEL
SEATING: 44

ORDERED: 12/1964
DELIVERY: 1/1968
REMARKS:

WITHDRAWN: 8/1974
DISPOSAL: 6/1975

BUS NUMBER: 723 SERIAL NUMBER: 36045

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT: 21,100 lbs.(9 571 kg)

ENGINE: CUMMINS V6-200
HORSEPOWER: 192(143 kW)
FUEL: DIESEL
SEATING: 44

ORDERED: 12/1964
DELIVERY: 8/1967
REMARKS:

WITHDRAWN: 1974
DISPOSAL: 2/1976

BUS NUMBER: 724
SERIAL NUMBER: 36046

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT: 21,100 lbs.(9 571 kg)

ENGINE: CUMMINS V6-200
HORSEPOWER: 192(143 kW)
FUEL: DIESEL
SEATING: 44

ORDERED: 12/1964
DELIVERY: 7/1967
REMARKS:

WITHDRAWN: 1974
DISPOSAL: 2/1976

BUS NUMBER: 725
SERIAL NUMBER: 36047

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT: 21,100 lbs.(9 571 kg)

ENGINE: CUMMINS V6-200
HORSEPOWER: 192(143 kW)
FUEL: DIESEL
SEATING: 44

ORDERED: 12/1964
DELIVERY: 7/1967
REMARKS:

WITHDRAWN: 8/1974
DISPOSAL: 6/1975

BUS NUMBER: 726
SERIAL NUMBER: 36048

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT: 21,100 lbs.(9 571 kg)

ENGINE: CUMMINS V6-200
HORSEPOWER: 192(143 kW)
FUEL: DIESEL
SEATING: 44

ORDERED: 12/1964
DELIVERY: 12/1967
REMARKS:

WITHDRAWN: 1974
DISPOSAL: 2/1976

BUS NUMBER: 727
SERIAL NUMBER: 36049

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT: 21,100 lbs.(9 571 kg)

ENGINE: CUMMINS V6-200
HORSEPOWER: 192(143 kW)
FUEL: DIESEL
SEATING: 44

ORDERED: 12/1964
DELIVERY: 7/1967
REMARKS:

WITHDRAWN: 8/1974
DISPOSAL: 6/1975

BUS NUMBER: 728
SERIAL NUMBER: 36050

MFR/MODEL: CHASSIS-DAIMLER, BODY-DUPLE; SRC6 ROADLINER

LENGTH: 36'4.5"(11 087 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'2"(3 099 mm)
WEIGHT: 21,100 lbs.(9 571 kg)

ENGINE: CUMMINS V6-200
HORSEPOWER: 192(143 kW)
FUEL: DIESEL
SEATING: 44

ORDERED: 12/1964
DELIVERY: 7/1967
REMARKS:

WITHDRAWN: 8/1974
DISPOSAL: 6/1975

BUS NUMBER: 494-500
SERIAL NUMBER: C700-C706

MFR/MODEL: GMC TDH-5303

LENGTH: 40'4"(12 294 mm)
WIDTH: 9'5.75"(2 889 mm)
HEIGHT: 9'10"(2 947 mm)
WEIGHT: 21,500 lbs.(9 752 kg)

ENGINE: GM 6V-71
HORSEPOWER: 188(140 kW)
FUEL: DIESEL
SEATING: 52

ORDERED: 2/1965
DELIVERY: 6/1966
REMARKS:

WITHDRAWN:
DISPOSAL:

BUS NUMBER: 501/2nd-510/2nd
SERIAL NUMBER: C707-C716

MFR/MODEL: GMC TDH-5303

LENGTH: 40'4"(12 294 mm)
WIDTH: 9'5.75"(2 889 mm)
HEIGHT: 9'10"(2 947 mm)
WEIGHT: 21,500 lbs.(9 752 kg)

ENGINE: GM 6V-71
HORSEPOWER: 188(140 kW)
FUEL: DIESEL
SEATING: 52

ORDERED: 2/1965
DELIVERY: 6/1966
REMARKS:

WITHDRAWN:
DISPOSAL:

BUS NUMBER: 1-9/2nd
SERIAL NUMBER:

MFR/MODEL: TWIN COACH 41S

LENGTH: 32'10"(10 008 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 9'(2 743 mm)
WEIGHT: 24,000 lbs.(10 886 kg

ENGINE: FTC-180
HORSEPOWER: 180(134 kW)
FUEL: GASOLINE
SEATING: 41

BUILT: 1947
DELIVERY: 11/1962

WITHDRAWN: 1968
DISPOSAL: 1968-1969

REMARKS: FORMER 501-509, RENUMBERED 6/1966

BUS NUMBER: 511/2nd-520/2nd
SERIAL NUMBER: C783-C792

MFR/MODEL: GMC TDH-5303

LENGTH: 40'4"(12 294 mm)
WIDTH: 9'5.75"(2 889 mm)
HEIGHT: 9'10"(2 997 mm)
WEIGHT: 21,500 lbs.(9 752 kg)

ENGINE: GM 6V-71
HORSEPOWER: 188(140 kW)
FUEL: DIESEL
SEATING: 52

ORDERED: 12/1966
DELIVERY: 1967
REMARKS:

WITHDRAWN: N/A
DISPOSAL: N/A

BUS NUMBER: 521-535 SERIAL NUMBER: C793-C807

MFR/MODEL: GMC TDH-5303

LENGTH: 40'4"(12 294 mm) ENGINE: GM 6V-71
WIDTH: 9'5.75"(2 889 mm) HORSEPOWER: 188(140 kW)
HEIGHT: 9'10"(2 997 mm) FUEL: DIESEL
WEIGHT: 21,500 lbs.(9 752 kg) SEATING: 52

ORDERED: 12/1966 WITHDRAWN: N/A
DELIVERY: 1967 DISPOSAL: N/A
REMARKS:

BUS NUMBER: 11-12/2nd SERIAL NUMBER:

MFR/MODEL: TWIN COACH 38S

LENGTH: 31'(9 449 mm) ENGINE: FTC-180
WIDTH: 8'(2 438 mm) HORSEPOWER: 180(134 kW)
HEIGHT: 9'(2 743 mm) FUEL: GASOLINE
WEIGHT: 24,000 lbs.(10 886 kg SEATING: 38

BUILT: 1946 WITHDRAWN: 1968
DELIVERY: 11/1962 DISPOSAL: 1969-1970
REMARKS: FORMER 512-513, RENUMBERED 6/1966

BUS NUMBER: 13/2nd SERIAL NUMBER: 914C

MFR/MODEL: TWIN COACH 38S

LENGTH: 31'(9 449 mm) ENGINE: FTC-180
WIDTH: 8'(2 438 mm) HORSEPOWER: 180(134 kW)
HEIGHT: 9'(2 743 mm) FUEL: GASOLINE
WEIGHT: 24,000 lbs.(10 886 kg SEATING: 38

BUILT: 1948 WITHDRAWN: 1968
DELIVERY: 11/1962 DISPOSAL: 9/1969
REMARKS: FORMER 516, RENUMBERED 6/1966

BUS NUMBER: 14/2nd SERIAL NUMBER: 917C

MFR/MODEL: TWIN COACH 38S

LENGTH: 31'(9 449 mm) ENGINE: FTC-180
WIDTH: 8'(2 438 mm) HORSEPOWER: 180(134 kW)
HEIGHT: 9'(2 743 mm) FUEL: GASOLINE
WEIGHT: 24,000 lbs.(10 886 kg SEATING: 38

BUILT: 1948 WITHDRAWN: 1968
DELIVERY: 11/1962 DISPOSAL:
REMARKS: FORMER 519, RENUMBERED 6/1966

BUS NUMBER: 1-10/3rd SERIAL NUMBER: C004-C013

MFR/MODEL: GMC T6H-4521

LENGTH: 35'3"(10 744 mm) ENGINE: GM 6V-71
WIDTH: 8'(2 438 mm) HORSEPOWER: 188(140 kW)
HEIGHT: 10'0.25"(3 054 mm) FUEL: DIESEL
WEIGHT: 19,700 lbs.(8 936 kg) SEATING: 45

ORDERED: 2/1968 WITHDRAWN: N/A
DELIVERY: 1968 DISPOSAL: N/A
REMARKS:

BUS NUMBER: 600 SERIAL NUMBER: 00092

MFR/MODEL: MITSUBISHI-FUSO, MAR750L

LENGTH: 39'11.5"(12 179 mm) ENGINE: MITSUBISHI 8DB20A
WIDTH: 8'2"(2 490 mm) HORSEPOWER: 233(174 kW)
HEIGHT: 10'2"(3 100 mm) FUEL: DIESEL
WEIGHT: 22,920 lbs.(10 420 kg SEATING: 51

BUILT: 1963 WITHDRAWN: 6/1971
DELIVERY: 3/1964 DISPOSAL: 1971
REMARKS: FORMER 10, RENUMBERED IN 1968

BUS NUMBER: 11-14/3rd
SERIAL NUMBER: C115-C118

MFR/MODEL: GMC T6H-4521

LENGTH: 35'3"(10 744 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'0.25"(3 054 mm)
WEIGHT: 19,700 lbs.(8 936 kg)

ENGINE: GM 6V-71
HORSEPOWER: 188(140 kW)
FUEL: DIESEL
SEATING: 45

ORDERED: 6/1969
DELIVERY: 1969
REMARKS:

WITHDRAWN: N/A
DISPOSAL: N/A

BUS NUMBER: 15-25/2nd
SERIAL NUMBER: C119-C129

MFR/MODEL: GMC T6H-4521

LENGTH: 35'3"(10 744 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 10'0.25"(3 054 mm)
WEIGHT: 19,700 lbs.(8 936 kg)

ENGINE: GM 6V-71
HORSEPOWER: 188(140 kW)
FUEL: DIESEL
SEATING: 45

ORDERED: 6/1969
DELIVERY: 1969
REMARKS:

WITHDRAWN: N/A
DISPOSAL: N/A

BUS NUMBER: 99
SERIAL NUMBER: 48-2766

MFR/MODEL: CCF-BRILL, C-36

LENGTH: 30'9.5"(9 385 mm)
WIDTH: 7'11.75"(2 432 mm)
HEIGHT: 9'6"(2 896 mm)
WEIGHT: 15,085 lbs.(6 843 kg)

ENGINE: HALL-SCOTT 136, 6-CYL.
HORSEPOWER: 150(112 kW)
FUEL: GASOLINE
SEATING: 36

ORDERED: 1948
DELIVERY: 10/1948
REMARKS: NOT IN SERVICE, PRESERVED BY ETS

WITHDRAWN: 1969
DISPOSAL: 1969

BUS NUMBER: 700 SERIAL NUMBER: 7222

MFR/MODEL: WFC D700A

LENGTH: 40'6.25"(12 351 mm) ENGINE: DETROIT DIESEL 6V-71
WIDTH: 8'6"(2 591 mm) HORSEPOWER: 188(140 kW)
HEIGHT: 10'3"(3 124 mm) FUEL: DIESEL
WEIGHT: 22,900 lbs.(10 387 kg SEATING: 51

BUILT: 1970 WITHDRAWN: 1978
DELIVERY: 4/1972 DISPOSAL: 1978
REMARKS: LEASED 1971; RENUMBERED 800 IN 1977

BUS NUMBER: 536-569 SERIAL NUMBER: C067-C100

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm) ENGINE: GM 6V-71N
WIDTH: 8'5.75"(2 585 mm) HORSEPOWER: 219(163 kW)
HEIGHT: 10'(3 048 mm) FUEL: DIESEL
WEIGHT: SEATING: 49

ORDERED: 4/1972 WITHDRAWN: N/A
DELIVERY: 10-11/1972 DISPOSAL: N/A
REMARKS:

BUS NUMBER: 26-35/2nd SERIAL NUMBER: C087-C096

MFR/MODEL: GMC T6H-4523N

LENGTH: 35'3"(10 744 mm) ENGINE: GM 6V-71N
WIDTH: 8'(2 438 mm) HORSEPOWER: 219(163 kW)
HEIGHT: 10'0.25"(3 054 mm) FUEL: DIESEL
WEIGHT: 19,700 lbs.(8 936 kg) SEATING: 45

ORDERED: 6/1973 WITHDRAWN: N/A
DELIVERY: 11-12/1973 DISPOSAL: N/A
REMARKS:

BUS NUMBER: 570-590
SERIAL NUMBER: C595-C615

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'5.75"(2 585 mm)
HEIGHT: 10'(3 048 mm)
WEIGHT:

ENGINE: GM 6V-71N
HORSEPOWER: 219(163 kW)
FUEL: DIESEL
SEATING: 49

ORDERED: 6/1973
DELIVERY: 11-12/1973
REMARKS:

WITHDRAWN: N/A
DISPOSAL: N/A

BUS NUMBER: 731-740
SERIAL NUMBER: 373-382

MFR/MODEL: FIL SERIES D800, MODEL D10240

LENGTH: 40'(12 192 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'4"(3 150 mm)
WEIGHT:

ENGINE: DETROIT DIESEL 6V-71
HORSEPOWER: 188(140 kW)
FUEL: DIESEL
SEATING: 49

ORDERED: 6/1973
DELIVERY: 7/1974
REMARKS: RENUMBERED 831-840, 1977

WITHDRAWN:
DISPOSAL:

BUS NUMBER: 591-599
SERIAL NUMBER: C993-C1001

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'5.75"(2 591 mm)
HEIGHT: 10'(3 048 mm)
WEIGHT:

ENGINE: GM 6V-71N
HORSEPOWER: 219(163 kW)
FUEL: DIESEL
SEATING: 49

ORDERED: 1973
DELIVERY: 11-12/1974
REMARKS:

WITHDRAWN: N/A
DISPOSAL: N/A

BUS NUMBER: 600/2nd
SERIAL NUMBER: C1002

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'5.75"(2 591 mm)
HEIGHT: 10'(3 048 mm)
WEIGHT:

ENGINE: GM 6V-71N
HORSEPOWER: 219(163 kW)
FUEL: DIESEL
SEATING: 49

ORDERED: 1973
DELIVERY: 11-12/1974
REMARKS:

WITHDRAWN: N/A
DISPOSAL: N/A

BUS NUMBER: 301-321
SERIAL NUMBER: C1003-C1023

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'5.75"(2 591 mm)
HEIGHT: 10'(3 048 mm)
WEIGHT:

ENGINE: GM 6V-71N
HORSEPOWER: 219(163 kW)
FUEL: DIESEL
SEATING: 49

ORDERED: 1973
DELIVERY: 11-12/1974
REMARKS: INCORRECTLY NUMBERED 601-621 BY GMC

WITHDRAWN: N/A
DISPOSAL: N/A

BUS NUMBER: 322-371
SERIAL NUMBER: C1350-C1399

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'5.75"(2 591 mm)
HEIGHT: 10'(3 048 mm)
WEIGHT:

ENGINE: GM 6V-71N
HORSEPOWER: 219(163 kW)
FUEL: DIESEL
SEATING: 49

ORDERED: 1974
DELIVERY: 7-8/1975
REMARKS:

WITHDRAWN: N/A
DISPOSAL: N/A

BUS NUMBER: 372-396
SERIAL NUMBER: C1481-C1505

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'5.75"(2 591 mm)
HEIGHT: 10'(3 048 mm)
WEIGHT:

ENGINE: GM 6V-71N
HORSEPOWER: 219(163 kW)
FUEL: DIESEL
SEATING: 47

ORDERED: 1974
DELIVERY: 12/1975
REMARKS:

WITHDRAWN: N/A
DISPOSAL: N/A

BUS NUMBER: 801/2nd-805/2nd
SERIAL NUMBER:

MFR/MODEL: BLUEBIRD SCHOOL BUS, FC3400

LENGTH:
WIDTH:
HEIGHT:
WEIGHT:

ENGINE:
HORSEPOWER:
FUEL: GASOLINE
SEATING: 72

ORDERED: 1974
DELIVERY: 1975
REMARKS: SCHOOL SERVICE ONLY, SOLD

WITHDRAWN: 1981
DISPOSAL: 1981

BUS NUMBER: 806-810
SERIAL NUMBER:

MFR/MODEL: BLUEBIRD SCHOOL BUS, FC3400

LENGTH:
WIDTH:
HEIGHT:
WEIGHT:

ENGINE:
HORSEPOWER:
FUEL: GASOLINE
SEATING: 72

ORDERED: 1974
DELIVERY: 1975
REMARKS: SCHOOL SERVICE ONLY, SOLD

WITHDRAWN: 1981
DISPOSAL: 1981

BUS NUMBER: 1-10(SPEC.) SERIAL NUMBER: C1596-C1605

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm) ENGINE: GM 6V-71N
WIDTH: 8'5.75"(2 591 mm) HORSEPOWER: 219(163 kW)
HEIGHT: 10'(3 048 mm) FUEL: DIESEL
WEIGHT: SEATING: 49

ORDERED: 1975 WITHDRAWN: N/A
DELIVERY: 2/1976 DISPOSAL: N/A
REMARKS: ST. ALBERT SERVICE, RENUMBERED 811-820 IN 1977

BUS NUMBER: 397-399 SERIAL NUMBER: C1626-C1628

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm) ENGINE: GM 6V-71N
WIDTH: 8'5.75"(2 591 mm) HORSEPOWER: 219(163 kW)
HEIGHT: 10'(3 048 mm) FUEL: DIESEL
WEIGHT: SEATING: 47

ORDERED: 1975 WITHDRAWN: N/A
DELIVERY: 4-5/1976 DISPOSAL: N/A
REMARKS:

BUS NUMBER: 601-613/2nd SERIAL NUMBER: C1629-C1641

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm) ENGINE: GM 6V-71N
WIDTH: 8'5.75"(2 591 mm) HORSEPOWER: 219(163 kW)
HEIGHT: 10'(3 048 mm) FUEL: DIESEL
WEIGHT: SEATING: 47

ORDERED: 1975 WITHDRAWN: N/A
DELIVERY: 4-5/1976 DISPOSAL: N/A
REMARKS:

BUS NUMBER: 614-657
SERIAL NUMBER: C1642-C1685

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'5.75"(2 591 mm)
HEIGHT: 10'(3 048 mm)
WEIGHT:

ENGINE: GM 6V-71N
HORSEPOWER: 219(163 kW)
FUEL: DIESEL
SEATING: 47

ORDERED: 1975
DELIVERY: 4-5/1976
REMARKS:

WITHDRAWN: N/A
DISPOSAL: N/A

BUS NUMBER: 658-697
SERIAL NUMBER: C1733-C1772

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'5.75"(2 591 mm)
HEIGHT: 10'(3 048 mm)
WEIGHT:

ENGINE: GM 6V-71N
HORSEPOWER: 219(163 kW)
FUEL: DIESEL
SEATING: 47

ORDERED:
DELIVERY: 1976
REMARKS:

WITHDRAWN: N/A
DISPOSAL: N/A

BUS NUMBER: 698-699
SERIAL NUMBER: C1868-C1869

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'5.75"(2 591 mm)
HEIGHT: 10'(3 048 mm)
WEIGHT:

ENGINE: GM 6V-71N
HORSEPOWER: 219(163 kW)
FUEL: DIESEL
SEATING: 47

ORDERED:
DELIVERY: 1977
REMARKS:

WITHDRAWN: N/A
DISPOSAL: N/A

BUS NUMBER: 700/2nd
SERIAL NUMBER: C1870

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'5.75"(2 591 mm)
HEIGHT: 10'(3 048 mm)
WEIGHT:

ENGINE: GM 6V-71N
HORSEPOWER: 219(163 kW)
FUEL: DIESEL
SEATING: 47

ORDERED:
DELIVERY: 1977
REMARKS:

WITHDRAWN: N/A
DISPOSAL: N/A

BUS NUMBER: 800
SERIAL NUMBER: 7222

MFR/MODEL: WFC D700A

LENGTH: 40'6.25"(12 351 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'3"(3 124 mm)
WEIGHT: 22,900 lbs.(10 387 kg

ENGINE: DETROIT DIESEL 6V-71
HORSEPOWER: 188(140 kW)
FUEL: DIESEL
SEATING: 51

BUILT: 1970
DELIVERY: 4/1972

WITHDRAWN: 1978
DISPOSAL: 1978

REMARKS: FORMER 700, RENUMBERED IN 1977

BUS NUMBER: 701/2nd-728/2nd
SERIAL NUMBER: C1871-C1898

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'5.75"(2 591 mm)
HEIGHT: 10'(3 048 mm)
WEIGHT:

ENGINE: GM 6V-71N
HORSEPOWER: 219(163 kW)
FUEL: DIESEL
SEATING: 47

ORDERED:
DELIVERY: 1977
REMARKS:

WITHDRAWN: N/A
DISPOSAL: N/A

BUS NUMBER: 729-732
SERIAL NUMBER: C1899-C1902

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'5.75"(2 591 mm)
HEIGHT: 10'(3 048 mm)
WEIGHT:
ENGINE: GM 6V-71N
HORSEPOWER: 219(163 kW)
FUEL: DIESEL
SEATING: 47

ORDERED:
DELIVERY: 1977
REMARKS:
WITHDRAWN: N/A
DISPOSAL: N/A

BUS NUMBER: 831/2nd-840/2nd.
SERIAL NUMBER: 0373-0382

MFR/MODEL: FIL, SERIES D800, MODEL D10240

LENGTH: 40'(12 192 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'4"(3 150 mm)
WEIGHT:
ENGINE: DETROIT DIESEL 6V-71
HORSEPOWER: 188(140 kW)
FUEL: DIESEL
SEATING: 49

ORDERED: 6/1973
DELIVERY: 7/1974
WITHDRAWN:
DISPOSAL:
REMARKS: FORMER 731-740, RENUMBERED IN 1977

BUS NUMBER: 811-820
SERIAL NUMBER: C1596-C1605

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'5.75"(2 591 mm)
HEIGHT: 10'(3 048 mm)
WEIGHT:
ENGINE: GM 6V-71N
HORSEPOWER: 219(163 kW)
FUEL: DIESEL
SEATING: 49

ORDERED: 1975
DELIVERY: 2/1976
WITHDRAWN: N/A
DISPOSAL: N/A
REMARKS: ST. ALBERT SERVICE ONLY, FORMER 1-10(SPEC.), REN. IN 1977

BUS NUMBER: 821
SERIAL NUMBER: C1911

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'5.75"(2 591 mm)
HEIGHT: 10'(3 048 mm)
WEIGHT:

ENGINE: GM 6V-71N
HORSEPOWER: 219(163 kW)
FUEL: DIESEL
SEATING: 49

ORDERED:
DELIVERY: 1977
REMARKS: ST. ALBERT SERVICE ONLY

WITHDRAWN: N/A
DISPOSAL: N/A

BUS NUMBER: 841-858
SERIAL NUMBER: 1284-1301

MFR/MODEL: FIL, SERIES D800, MODEL D10240

LENGTH: 40'(12 192 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'4"(3 150 mm)
WEIGHT:

ENGINE: DETROIT DIESEL 6V-71N
HORSEPOWER: 219(163 kW)
FUEL: DIESEL
SEATING: 49

ORDERED:
DELIVERY: 1977
REMARKS:

WITHDRAWN: N/A
DISPOSAL: N/A

BUS NUMBER: 859/2nd-868/2nd
SERIAL NUMBER: C1916-C1925

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'5.75"(2 591 mm)
HEIGHT: 10'(3 048 mm)
WEIGHT:

ENGINE: GM 6V-71N
HORSEPOWER: 219(163 kW)
FUEL: DIESEL
SEATING: 49

ORDERED:
DELIVERY: 1977
REMARKS: COUNTY OF STRATHCONA SERVICE ONLY

WITHDRAWN: N/A
DISPOSAL: N/A

BUS NUMBER: 733-767
SERIAL NUMBER: C2030-C2064

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'5.75"(2 591 mm)
HEIGHT: 10'(3 048 mm)
WEIGHT:

ENGINE: GM 6V-71N
HORSEPOWER: 219(163 kW)
FUEL: DIESEL
SEATING: 47

ORDERED:
DELIVERY: 1977
REMARKS:

WITHDRAWN: N/A
DISPOSAL: N/A

BUS NUMBER: 768-799
SERIAL NUMBER: C2199-C2230

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'5.75"(2 591 mm)
HEIGHT: 10'(3 048 mm)
WEIGHT:

ENGINE: GM 6V-71N
HORSEPOWER: 219(163 kW)
FUEL: DIESEL
SEATING: 47

ORDERED: 1977
DELIVERY: 1978
REMARKS:

WITHDRAWN: N/A
DISPOSAL: N/A

BUS NUMBER: 900-925
SERIAL NUMBER: C2231-C2256

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'5.75"(2 591 mm)
HEIGHT: 10'(3 048 mm)
WEIGHT:

ENGINE: GM 6V-71N
HORSEPOWER: 219(163 kW)
FUEL: DIESEL
SEATING: 47

ORDERED: 1977
DELIVERY: 1978
REMARKS:

WITHDRAWN: N/A
DISPOSAL: N/A

BUS NUMBER: 822-824
SERIAL NUMBER: M1199-M1201

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'5.75"(2 591 mm)
HEIGHT: 10'(3 048 mm)
WEIGHT:

ENGINE: GM 6V-71N
HORSEPOWER: 219(163 kW)
FUEL: DIESEL
SEATING:

ORDERED:
DELIVERY: 1979

WITHDRAWN: N/A
DISPOSAL: N/A

REMARKS: ST. ALBERT SERVICE ONLY

BUS NUMBER: 926-955
SERIAL NUMBER: M1814-M1843

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'5.75"(2 591 mm)
HEIGHT: 10'(3 048 mm)
WEIGHT:

ENGINE: GM 6V-71N
HORSEPOWER: 219(163 kW)
FUEL: DIESEL
SEATING: 49

ORDERED: 7/1979
DELIVERY: 1980

WITHDRAWN: N/A
DISPOSAL: N/A

REMARKS: HAVE ELECTRONIC SIGNS & CLOTH UPHOLSTERY

BUS NUMBER: 956-995
SERIAL NUMBER: M1844-M1883

MFR/MODEL: GMC T6H-5307N

LENGTH: 39'11"(12 167 mm)
WIDTH: 8'5.75"(2 591 mm)
HEIGHT: 10'(3 048 mm)
WEIGHT:

ENGINE: GM 6V-71N
HORSEPOWER: 219(163 kW)
FUEL: DIESEL
SEATING: 47

ORDERED: 7/1979
DELIVERY: 1980

WITHDRAWN: N/A
DISPOSAL: N/A

REMARKS: 956-970 HAVE ELECTRONIC SIGNS

BUS NUMBER: 825-827	SERIAL NUMBER: M1990-M1992
MFR/MODEL: GMC T6H-5307N	
LENGTH: 39'11"(12 167 mm)	ENGINE: GM 6V-71N
WIDTH: 8'5.75"(2 591 mm)	HORSEPOWER: 192(143 kW)
HEIGHT: 10'(3 048 mm)	FUEL: DIESEL
WEIGHT:	SEATING:
ORDERED:	WITHDRAWN: N/A
DELIVERY: 1980	DISPOSAL: N/A

REMARKS: ST. ALBERT SERVICE ONLY

BUS NUMBER: N/A
SERIAL NUMBER:

MFR/MODEL: GMC

LENGTH:
WIDTH:
HEIGHT:
WEIGHT:

ENGINE: GMC
HORSEPOWER:
FUEL: GASOLINE
SEATING: 21

ORDERED: N/A
DELIVERY: 11/1938
WITHDRAWN: 11/1941
DISPOSAL: N/A
REMARKS: LEASED FROM BUS UNIVERSAL SUPPLY LTD.

BUS NUMBER: N/A
SERIAL NUMBER:

MFR/MODEL: GMC

LENGTH:
WIDTH:
HEIGHT:
WEIGHT:

ENGINE: GMC
HORSEPOWER:
FUEL: GASOLINE
SEATING: 21

ORDERED: N/A
DELIVERY: 11/1938
WITHDRAWN: 11/1941
DISPOSAL: N/A
REMARKS: LEASED FROM BUS UNIVERSAL SUPPLY LTD.

BUS NUMBER: N/A SERIAL NUMBER: 6-G-3466

MFR/MODEL: FORD MOTOR CO.

LENGTH: ENGINE: FORD
WIDTH: HORSEPOWER:
HEIGHT: FUEL: GASOLINE
WEIGHT: SEATING:

ORDERED: N/A WITHDRAWN: 2/1947
DELIVERY: 1946 DISPOSAL: N/A
REMARKS: LEASED FROM MCMULLEN & NOULLETT

BUS NUMBER: (M132) SERIAL NUMBER: 218

MFR/MODEL: TWIN COACH, 41S

LENGTH: 32'10"(10 008 mm) ENGINE: FTC-180
WIDTH: 8'(2 438 mm) HORSEPOWER: 180(134 kW)
HEIGHT: 9'(2 743 mm) FUEL: GASOLINE
WEIGHT: 24,000 lbs.(10 886 kg SEATING: 41

ORDERED: N/A WITHDRAWN: 3/1952
DELIVERY: 12/1951 DISPOSAL: N/A
REMARKS: LEASED FROM B.C. ELECTRIC, VANCOUVER

BUS NUMBER: (M133) SERIAL NUMBER: 216

MFR/MODEL: TWIN COACH, 41S

LENGTH: 32'10"(10 008 mm) ENGINE: FTC-180
WIDTH: 8'(2 438 mm) HORSEPOWER: 180(134 kW)
HEIGHT: 9'(2 743 mm) FUEL: GASOLINE
WEIGHT: 24,000 lbs.(10 886 kg SEATING: 41

ORDERED: N/A WITHDRAWN: 3/1952
DELIVERY: 12/1951 DISPOSAL: N/A
REMARKS: LEASED FROM B.C. ELECTRIC, VANCOUVER

Leased Buses

BUS NUMBER: (M134)
SERIAL NUMBER: 233

MFR/MODEL: TWIN COACH, 41S

LENGTH: 32'10"(10 008 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 9'(2 743 mm)
WEIGHT: 24,000 lbs.(10 886 kg
ENGINE: FTC-180
HORSEPOWER: 180(134 kW)
FUEL: GASOLINE
SEATING: 41

ORDERED: N/A
DELIVERY: 12/1951
WITHDRAWN: 3/1952
DISPOSAL: N/A
REMARKS: LEASED FROM B.C. ELECTRIC, VANCOUVER

BUS NUMBER: (M135)
SERIAL NUMBER: 141

MFR/MODEL: TWIN COACH, 41S

LENGTH: 32'10"(10 008 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 9'(2 743 mm)
WEIGHT: 24,000 lbs.(10 886 kg
ENGINE: FTC-180
HORSEPOWER: 180(134 kW)
FUEL: GASOLINE
SEATING: 41

ORDERED: N/A
DELIVERY: 12/1951
WITHDRAWN: 3/1952
DISPOSAL: N/A
REMARKS:

BUS NUMBER: (M136)
SERIAL NUMBER: 213

MFR/MODEL: TWIN COACH, 41S

LENGTH: 32'10"(10 008 mm)
WIDTH: 8'(2 438 mm)
HEIGHT: 9'(2 743 mm)
WEIGHT: 24,000 lbs.(10 886 kg
ENGINE: FTC-180
HORSEPOWER: 180(134 kW)
FUEL: GASOLINE
SEATING: 41

ORDERED: N/A
DELIVERY: 12/1951
WITHDRAWN: 3/1952
DISPOSAL: N/A
REMARKS: LEASED FROM B.C. ELECTRIC, VANCOUVER

BUS NUMBER: (M137) SERIAL NUMBER: 207

MFR/MODEL: TWIN COACH, 41S

LENGTH: 32'10"(10 008 mm) ENGINE: FTC-180
WIDTH: 8'(2 438 mm) HORSEPOWER: 180(134 kW)
HEIGHT: 9'(2 743 mm) FUEL: GASOLINE
WEIGHT: 24,000 lbs.(10 886 kg. SEATING: 41

ORDERED: N/A WITHDRAWN: 3/1952
DELIVERY: 12/1951 DISPOSAL: N/A
REMARKS: LEASED FROM B.C. ELECTRIC, VANCOUVER

BUS NUMBER: (M138) SERIAL NUMBER: 219

MFR/MODEL: TWIN COACH, 41S

LENGTH: 32'10"(10 008 mm) ENGINE: FTC-180
WIDTH: 8'(2 438 mm) HORSEPOWER: 180(134 kW)
HEIGHT: 9'(2 743 mm) FUEL: GASOLINE
WEIGHT: 24,000 lbs.(10 886 kg SEATING: 41

ORDERED: N/A WITHDRAWN: 3/1952
DELIVERY: 12/1951 DISPOSAL: N/A
REMARKS: LEASED FROM B.C. ELECTRIC, VANCOUVER

BUS NUMBER: (M139) SERIAL NUMBER: 256

MFR/MODEL: TWIN COACH, 41S

LENGTH: 32'10"(10 008 mm) ENGINE: FTC-180
WIDTH: 8'(2 438 mm) HORSEPOWER: 180(134 kW)
HEIGHT: 9'(2 743 mm) FUEL: GASOLINE
WEIGHT: 24,000 lbs.(10 886 kg SEATING: 41

ORDERED: N/A WITHDRAWN: 3/1952
DELIVERY: 12/1951 DISPOSAL: N/A
REMARKS: LEASED FROM B.C. ELECTRIC, VANCOUVER

This section of the Appendix contains a chronological listing of all new and used trolley buses obtained and operated between 1939 and 1982. This section also includes a listing of used trolley buses that were purchased for parts only, but which were never put into service in Edmonton.

The information includes: the bus number, the serial number (if available), the manufacturers and the model designation, major dimensions, vehicle weight, motor designation and rating, number of axles, seating capacity, order and delivery dates, disposal date, and any cogent remarks.

BUS NUMBER: 101 SERIAL NUMBER: 087

MFR/MODEL: CHASSIS - AEC, BODY - EE, 663T

LENGTH: 32'(9 754 mm)
WIDTH: 8'3"(2 515 mm)
HEIGHT: 10'(3 048 mm)
WEIGHT: 18,620 lbs.(8 446 kg)

MOTOR: EE 408
HORSEPOWER: 115(85.8 kW)
AXLES: 3
SEATING: 38

ORDERED: 9/1938
DELIVERY: 9/1939
REMARKS: MODIFIED 1947-1948

WITHDRAWN: 1951
DISPOSAL: 1954

BUS NUMBER: 102 SERIAL NUMBER: 089

MFR/MODEL: CHASSIS - AEC, BODY - EE, 663T

LENGTH: 32'(9 754 mm)
WIDTH: 8'3"(2 515 mm)
HEIGHT: 10'(3 048 mm)
WEIGHT: 18,620 lbs.(8 446 kg)

MOTOR: EE 408
HORSEPOWER: 115(85.8 kW)
AXLES: 3
SEATING: 38

ORDERED: 9/1938
DELIVERY: 9/1939
REMARKS: MODIFIED 1947 - 1948

WITHDRAWN: 11/1950
DISPOSAL: 1954

BUS NUMBER: 103
SERIAL NUMBER: 088

MFR/MODEL: CHASSIS - AEC, BODY - EE, 663T

LENGTH: 32'(9 754 mm)
WIDTH: 8'3"(2 515 mm)
HEIGHT: 10'(3 048 mm)
WEIGHT: 18,620 lbs.(8 446 kg)

MOTOR: EE 408
HORSEPOWER: 115(85.8 kW)
AXLES: 3
SEATING: 38

ORDERED: 9/1938
DELIVERY: 9/1939
REMARKS: MODIFIED 1947 - 1948

WITHDRAWN: 11/1950
DISPOSAL: 1954

BUS NUMBER: 104-106
SERIAL NUMBER: 302343 to 302345

MFR/MODEL: CHASSIS - LEYLAND, BODY - PARK ROYAL COACH, TTB

LENGTH: 32'6"(9 906 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'3"(3 124 mm)
WEIGHT:

MOTOR: GEC WT 265
HORSEPOWER: 135(100.7 kW)
AXLES: 3
SEATING: 38

ORDERED: 9/1938
DELIVERY: 9/1939
REMARKS: MODIFIED 1947 - 1948

WITHDRAWN: 1950-1951
DISPOSAL: 1954

BUS NUMBER: 107
SERIAL NUMBER: 305790

MFR/MODEL: CHASSIS - LEYLAND, BODY - PARK ROYAL COACH, TTB

LENGTH: 32'6"(9 906 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'3"(3 124 mm)
WEIGHT:

MOTOR: GEC WT 265
HORSEPOWER: 135(100.7 kW)
AXLES: 3
SEATING: 38

ORDERED: 11/1939
DELIVERY: 7/1942
REMARKS: MODIFIED 1947 - 1948

WITHDRAWN: 1951
DISPOSAL: 1954

BUS NUMBER: 108 SERIAL NUMBER: 305792

MFR/MODEL: CHASSIS - LEYLAND, BODY - PARK ROYAL COACH, TTB

LENGTH: 32'6"(9 906 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'3"(3 124 mm)
WEIGHT:

MOTOR: GEC WT 265
HORSEPOWER: 135(100.7 kW)
AXLES: 3
SEATING: 38

ORDERED: 11/1939
DELIVERY: 7/1942
REMARKS: MODIFIED 1947 - 1948

WITHDRAWN: 1951
DISPOSAL: 1954

BUS NUMBER: 109 SERIAL NUMBER: 305791

MFR/MODEL: CHASSIS - LEYLAND, BODY - PARK ROYAL COACH, TTB

LENGTH: 32'6"(9 906 mm)
WIDTH: 8'2"(2 489 mm)
HEIGHT: 10'3"(3 124 mm)
WEIGHT:

MOTOR: GEC WT 265
HORSEPOWER: 135(100.7 kW)
AXLES: 3
SEATING: 38

ORDERED: 11/1939
DELIVERY: 7/1942
REMARKS: MODIFIED 1947 - 1948

WITHDRAWN: 1951
DISPOSAL: 1954

BUS NUMBER: 110-112 SERIAL NUMBER: 1276-1278

MFR/MODEL: MACK MANUFACTURING, CR

LENGTH: 34'11.5"(10 655 mm)
WIDTH: 8'3"(2 515 mm)
HEIGHT: 9'8"(2 946 mm)
WEIGHT: 21,440 lbs.(9 707 kg)

MOTOR: GE 1213D7
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 40

ORDERED: 5/1942
DELIVERY: 2/1943
REMARKS:

WITHDRAWN: 10/1962
DISPOSAL: 1964

BUS NUMBER: 113-115
SERIAL NUMBER: 5497-5499

MFR/MODEL: PULLMAN-STANDARD, 41CS-100-44CX

LENGTH: 37'9"(11 506 mm)
WIDTH: 8'4.15"(2 544 mm)
HEIGHT: 10'9.5"(3 289 mm)
WEIGHT: 21,100 lbs.(9 571 kg)

MOTOR: GE 1213D7
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

ORDERED: 8/1943
DELIVERY: 7/1944
REMARKS:

WITHDRAWN: 1964-1966
DISPOSAL: 1964-1966

BUS NUMBER: 116
SERIAL NUMBER: 5500

MFR/MODEL: PULLMAN-STANDARD, 41CS-100-44CX

LENGTH: 37'9"(11 506 mm)
WIDTH: 8'4.15"(2 544 mm)
HEIGHT: 10'9.5"(3 289 mm)
WEIGHT: 21,100 lbs.(9 571 kg)

MOTOR: GE 1213D7
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

ORDERED: 8/1943
DELIVERY: 7/1944

WITHDRAWN: 3/1966
DISPOSAL: N/A

REMARKS: PRESERVED BY ETS, RENUMBERED 113

BUS NUMBER: 117-120
SERIAL NUMBER: 5501-5504

MFR/MODEL: PULLMAN-STANDARD, 41CS-100-44CX

LENGTH: 37'9"(11 506 mm)
WIDTH: 8'4.15"(2 544 mm)
HEIGHT: 10'9.5"(3 289 mm)
WEIGHT: 21,100 lbs.(9 571 kg)

MOTOR: GE 1213D7
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

ORDERED: 8/1943
DELIVERY: 7/1944
REMARKS:

WITHDRAWN: 1966
DISPOSAL: 1966

BUS NUMBER: 121-128
SERIAL NUMBER: 5679-5686

MFR/MODEL: PULLMAN-STANDARD, 44AS-100-44CX

LENGTH: 37'9"(11 506 mm)
WIDTH: 8'4.15"(2 544 mm)
HEIGHT: 10'9.5"(3 289 mm)
WEIGHT: 21,100 lbs.(9 571 kg)

MOTOR: GE 1213D7
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

ORDERED: 6/1944
DELIVERY: 8-9/1945
REMARKS:

WITHDRAWN: 1964-1966
DISPOSAL: 1964-1966

BUS NUMBER: 129
SERIAL NUMBER: 164 (U.L. 5071)

MFR/MODEL: ACF-BRILL, TC-44

LENGTH: 37'11.5"(11 570 mm)
WIDTH: 8'4.5"(2 553 mm)
HEIGHT: 9'6"(2 896 mm)
WEIGHT: 20,600 lbs.(9 344 kg)

MOTOR: GE 1213D7
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

ORDERED: 4/1945
DELIVERY: 11/1945
REMARKS:

WITHDRAWN: 4/1966
DISPOSAL: 1966

BUS NUMBER: 130
SERIAL NUMBER: 165 (U.L. 5872)

MFR/MODEL: ACF-BRILL, TC-44

LENGTH: 37'11.5"(11 570 mm)
WIDTH: 8'4.5"(2 553 mm)
HEIGHT: 9'6"(2 896 mm)
WEIGHT: 20,600 lbs.(9 344 kg)

MOTOR: GE 1213D7
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

ORDERED: 4/1945
DELIVERY: 11/1945
REMARKS:

WITHDRAWN: 4/1966
DISPOSAL: 1966

BUS NUMBER: 131-147
SERIAL NUMBER: 46-5023 - 46-5039

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA1
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

ORDERED: 10/1945
DELIVERY: 1-2/1947
REMARKS:

WITHDRAWN: 1973-1978
DISPOSAL: 1973-1979

BUS NUMBER: 148
SERIAL NUMBER: 47-5040

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA1
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

ORDERED: 10/1945
DELIVERY: 2/1947
REMARKS: PRESERVED BY E.T.

WITHDRAWN: 1978
DISPOSAL: N/A

BUS NUMBER: 149-152
SERIAL NUMBER: 47-5041 - 47-5044

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA1
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

ORDERED: 10/1945
DELIVERY: 2/1947
REMARKS:

WITHDRAWN: 1974-1978
DISPOSAL: 1974-1980

BUS NUMBER: 153-177
SERIAL NUMBER: 47-5176 - 47-5200

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA1
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

ORDERED: 3/1946
DELIVERY: 9/1947
REMARKS:

WITHDRAWN: 1973-1978
DISPOSAL: 1973-1980

BUS NUMBER: 178-179
SERIAL NUMBER: 48-5503, 48-5504

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

ORDERED: 3/1948
DELIVERY:
REMARKS:

WITHDRAWN: 1974-1975
DISPOSAL: 1974-1975

BUS NUMBER: 180-187
SERIAL NUMBER: 48-5542 - 48-5549

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

ORDERED: 3/1948
DELIVERY: 12/1948
REMARKS:

WITHDRAWN: 1974-1978
DISPOSAL: 1974-1979

BUS NUMBER: 188-190
SERIAL NUMBER: 49-5675 - 49-5677

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

ORDERED: 5/1949
DELIVERY: 11-12/1949
REMARKS:

WITHDRAWN: 1973-1978
DISPOSAL: 1973-1979

BUS NUMBER: 191
SERIAL NUMBER: 49-5678

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

ORDERED: 5/1949
DELIVERY: 12/1949
REMARKS: PRESERVED BY E.T.

WITHDRAWN: 1978
DISPOSAL: N/A

BUS NUMBER: 192
SERIAL NUMBER: 49-5679

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

ORDERED: 5/1949
DELIVERY: 12/1949
REMARKS:

WITHDRAWN: 1978
DISPOSAL: 1979

BUS NUMBER: 193-196 SERIAL NUMBER: 52-8276 - 52-8279

MFR/MODEL: CCF-BRILL, T-48A

LENGTH: 38'9.5"(11 824 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'6.25"(1 263 mm)
WEIGHT: 19,170 lbs.(8 696 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 48

ORDERED: 12/1951
DELIVERY: 3/1952
REMARKS:

WITHDRAWN: 1975-1978
DISPOSAL: 1975-1979

BUS NUMBER: 197-201 SERIAL NUMBER: 54-8340 - 54-8344

MFR/MODEL: CCF-BRILL, T-48A

LENGTH: 38'9.5"(11 824 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'6.25"(1 263 mm)
WEIGHT: 19,170 lbs.(8 696 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 42

ORDERED: 8/1954
DELIVERY:
REMARKS:

WITHDRAWN: 1978
DISPOSAL: 1979

BUS NUMBER: 202 SERIAL NUMBER: 54-8345

MFR/MODEL: CCF-BRILL, T-48A

LENGTH: 38'9.5"(11 824 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'6.25"(1 263 mm)
WEIGHT: 19,170 lbs.(8 696 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 42

ORDERED: 8/1954
DELIVERY:
REMARKS: PRESERVED BY E.T.

WITHDRAWN: 1978
DISPOSAL: N/A

BUS NUMBER: 203-212
SERIAL NUMBER: 47-5241 - 47-5250

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1947
DELIVERY: 1962

WITHDRAWN: 1974-1978
DISPOSAL: 1974-1979

REMARKS: FROM VANCOUVER, EX 2001-2010

BUS NUMBER: 113/2nd
SERIAL NUMBER: 5500

MFR/MODEL: PULLMAN-STANDARD, 41CS-100-44CX

LENGTH: 37'9"(11 506 mm)
WIDTH: 8'4.15"(2 544 mm)
HEIGHT: 10'9.5"(3 289 mm)
WEIGHT: 21,100 lbs.(9 571 kg)

MOTOR: GE 1213D7
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 8/1943
DELIVERY: 7/1944

WITHDRAWN: 3/1966
DISPOSAL: N/A

REMARKS: ex 116, RENUMBERED IN 1966

BUS NUMBER: 121/2nd
SERIAL NUMBER: 49-5662

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1949
DELIVERY: 1966

WITHDRAWN: 1978
DISPOSAL: 1979

REMARKS: FROM REGINA, ex 134

BUS NUMBER: 122/2nd
SERIAL NUMBER: 49-5655

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1949
DELIVERY: 1966
REMARKS: FROM REGINA, ex 127

WITHDRAWN: 1975
DISPOSAL: 1975

BUS NUMBER: 123/2nd
SERIAL NUMBER: 49-5661

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1949
DELIVERY: 1966
REMARKS: FROM REGINA, ex 133

WITHDRAWN: BEFORE 1978
DISPOSAL:

BUS NUMBER: 124/2nd
SERIAL NUMBER: 49-5656

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1949
DELIVERY: 1966
REMARKS: FROM REGINA, ex 128

WITHDRAWN: 1977
DISPOSAL: 1978

BUS NUMBER: 125/2nd
SERIAL NUMBER: 49-5653

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)
MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1949
DELIVERY: 1966
REMARKS: FROM REGINA, ex 125
WITHDRAWN: 1978
DISPOSAL: 1979

BUS NUMBER: 126/2nd
SERIAL NUMBER: 49-5663

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)
MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1949
DELIVERY: 1966
REMARKS: FROM REGINA, ex 135
WITHDRAWN: 1974
DISPOSAL: 1974

BUS NUMBER: 127/2nd
SERIAL NUMBER: 49-5664

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)
MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1949
DELIVERY: 1966
REMARKS: FROM REGINA, ex 136
WITHDRAWN: 1978
DISPOSAL:

BUS NUMBER: 128/2nd
SERIAL NUMBER: 49-5668

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1949
DELIVERY: 1966
REMARKS: FROM REGINA, ex 141

WITHDRAWN: 1978
DISPOSAL: 1979

BUS NUMBER: 129/2nd
SERIAL NUMBER: 49-5665

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1949
DELIVERY: 1966
REMARKS: FROM REGINA, ex 137

WITHDRAWN: 1978
DISPOSAL: 1979

BUS NUMBER: 130/2nd
SERIAL NUMBER: 49-5674

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1949
DELIVERY: 1966
REMARKS: FROM REGINA, ex 146

WITHDRAWN: 1978
DISPOSAL: 1979

BUS NUMBER: 213 SERIAL NUMBER: 395

MFR/MODEL: FIL, SERIES-E800, MODEL-E10240

LENGTH: 40'(12 192 mm) MOTOR: CGE 1213PA, RMFD.
WIDTH: 8'6"(2 591 mm) HORSEPOWER: 140(104.4 kW)
HEIGHT: 10'6"(3 200 mm) AXLES: 2
WEIGHT: SEATING: 49

ORDERED: 1973 WITHDRAWN: N/A
DELIVERY: 10/1974 DISPOSAL: N/A
REMARKS: BODY MODIFIED AND REPAINTED, 1979

BUS NUMBER: 214-237 SERIAL NUMBER: 396-419

MFR/MODEL: FIL, SERIES-E800, MODEL-E10240

LENGTH: 40'(12 192 mm) MOTOR: CGE 1213PA, RMFD.
WIDTH: 8'6"(2 591 mm) HORSEPOWER: 140(104.4 kW)
HEIGHT: 10'6"(3 200 mm) AXLES: 2
WEIGHT: SEATING: 49

ORDERED: 1973 WITHDRAWN: N/A
DELIVERY: 1975 DISPOSAL: N/A
REMARKS: BODIES MODIFIED AND REPAINTED, 1977-1981

BUS NUMBER: 238-249 SERIAL NUMBER: 420-431

MFR/MODEL: FIL, SERIES-E800, MODEL-E10240

LENGTH: 40'(12 192 mm) MOTOR: CGE 1213PA, RMFD.
WIDTH: 8'6"(2 591 mm) HORSEPOWER: 140(104.4 kW)
HEIGHT: 10'6"(3 200 mm) AXLES: 2
WEIGHT: SEATING: 49

ORDERED: 1973 WITHDRAWN: N/A
DELIVERY: 1976 DISPOSAL: N/A
REMARKS: BODIES MODIFIED AND REPAINTED, 1977-1981

BUS NUMBER: 100 SERIAL NUMBER: SEE LIST BELOW

MFR/MODEL: BBC/GMC, 5307N

LENGTH: 39'11"(12 167 mm) MOTOR: BBC
WIDTH: 8'5.75"(2 585 mm) HORSEPOWER: 184(137.3 kW)
HEIGHT: AXLES: 2
WEIGHT: 21,385 lbs.(9 700 kg) SEATING: 42

ORDERED: 1980 WITHDRAWN: N/A
DELIVERY: 1981 DISPOSAL: N/A
REMARKS: FINAL ASSEMBLY IN EDMONTON BY CONTRACTOR

BUS NUMBER: 101/2nd-112/2nd SERIAL NUMBER: SEE LIST BELOW

MFR/MODEL: BBC/GMC, 5307N

LENGTH: 39'11"(12 167 mm) MOTOR: BBC
WIDTH: 8'5.75"(2 585 mm) HORSEPOWER: 184(137.3 kW)
HEIGHT: AXLES: 2
WEIGHT: 21,385 lbs.(9 700 kg) SEATING: 42

ORDERED: 1980 WITHDRAWN: N/A
DELIVERY: 1982 DISPOSAL: N/A
REMARKS: FINAL ASSEMBLY IN EDMONTON BY CONTRACTOR

BUS NUMBER: 113/3rd SERIAL NUMBER: SEE LIST BELOW

MFR/MODEL: BBC/GMC, 5307N

LENGTH: 39'11"(12 167 mm) MOTOR: BBC
WIDTH: 8'5.75"(2 585 mm) HORSEPOWER: 184(137.3 kW)
HEIGHT: AXLES: 2
WEIGHT: 21,385 lbs.(9 700 kg) SEATING: 42

ORDERED: 1980 WITHDRAWN: N/A
DELIVERY: 1982 DISPOSAL: N/A
REMARKS: FINAL ASSEMBLY IN EDMONTON BY CONTRACTOR

BUS NUMBER: 114/2nd-199/2nd SERIAL NUMBER: SEE LIST BELOW

MFR/MODEL: BBC/GMC, 5307N

LENGTH: 39'11"(12 167 mm)	MOTOR: BBC
WIDTH: 8'5.75"(2 585 mm)	HORSEPOWER: 184(137.3 kW)
HEIGHT:	AXLES: 2
WEIGHT: 21,385 lbs.(9 700 kg)	SEATING: 42

ORDERED: 1980	WITHDRAWN: N/A
DELIVERY: 1982	DISPOSAL: N/A

REMARKS: FINAL ASSEMBLY IN EDMONTON BY CONTRACTOR

BUS	MFR	SERIAL NUMBER
100	B BOVERI	2B9546PD3BE001
101	B BOVERI	2B9546PD5BE002
102	B BOVERI	2B9546PD7BE003
103	B BOVERI	2B9546PD9BE004
104	B BOVERI	2B9546PD0BE005
105	B BOVERI	2B9546PD2BE006
106	B BOVERI	2B9546PD4BE007
107	B BOVERI	2B9546PD6BE008
108	B BOVERI	2B9546PD8BE009
109	B BOVERI	2B9546PD4BE010
110	B BOVERI	2B9546PD6BE011
111	B BOVERI	2B9546PD8BE012
112	B BOVERI	2B9546PDXBE013
113	B BOVERI	2B9546PD1BE014
114	B BOVERI	2B9546PD3BE015
115	B BOVERI	2B9546PD5BE016
116	B BOVERI	2B9546PD7BE017
117	B BOVERI	2B9546PD9BE018
118	B BOVERI	2B9546PD0BE019
119	B BOVERI	2B9546PD7BE020
120	B BOVERI	2B9546PD9BE021
121	B BOVERI	2B9546PD0BE022
122	B BOVERI	2B9546PD2BE023
123	B BOVERI	2B9546PD4BE024
124	B BOVERI	2B9546PD6BE025
125	B BOVERI	2B9546PD8BE026
126	B BOVERI	2B9546PDXBE027
127	B BOVERI	2B9546PD1BE028
128	B BOVERI	2B9546PD3BE029
129	B BOVERI	2B9546PDXBE030
130	B BOVERI	2B9546PD1BE031
131	B BOVERI	2B9546PD3BE032
132	B BOVERI	2B9546PD5BE033
133	B BOVERI	2B9546PD7BE034
134	B BOVERI	2B9546PD9BE035
135	B BOVERI	2B9546PD0BE036
136	B BOVERI	2B9546PD2BE037
137	B BOVERI	2B9546PD4BE038
138	B BOVERI	2B9546PD6BE039
139	B BOVERI	2B9546PD2BE040
140	B BOVERI	2B9546PD4BE041
141	B BOVERI	2B9546PD6BE042
142	B BOVERI	2B9546PD8BE043
143	B BOVERI	2B9546PDXBE044
144	B BOVERI	2B9546PD1BE045
145	B BOVERI	2B9546PD3BE046
146	B BOVERI	2B9546PD5BE047
147	B BOVERI	2B9546PD7BE048
148	B BOVERI	2B9546PD9BE049
149	B BOVERI	2B9546PD5BE050
150	B BOVERI	2B9546PD7BE051
151	B BOVERI	2B9546PD9BE052
152	B BOVERI	2B9546PD0BE053
153	B BOVERI	2B9546PD2BE054
154	B BOVERI	2B9546PD4BE055
155	B BOVERI	2B9546PD6BE056
156	B BOVERI	2B9546PD8BE057
157	B BOVERI	2B9546PDXBE058
158	B BOVERI	2B9546PD1BE059
159	B BOVERI	2B9546PD8BE060
160	B BOVERI	2B9546PDXBE061
161	B BOVERI	2B9546PD1BE062
162	B BOVERI	2B9546PD3BE063
163	B BOVERI	2B9546PD5BE064
164	B BOVERI	2B9546PD7BE065
165	B BOVERI	2B9546PD9BE066
166	B BOVERI	2B9546PD0BE067
167	B BOVERI	2B9546PD2BE068
168	B BOVERI	2B9546PD4BE069
169	B BOVERI	2B9546PD0BE070
170	B BOVERI	2B9546PD2BE071
171	B BOVERI	2B9546PD4BE072
172	B BOVERI	2B9546PD6BE073
173	B BOVERI	2B9546PD8BE074
174	B BOVERI	2B9546PDXBE075
175	B BOVERI	2B9546PD1BE076
176	B BOVERI	2B9546PD3BE077
177	B BOVERI	2B9546PD5BE078
178	B BOVERI	2B9546PD7BE079
179	B BOVERI	2B9546PD3BE080
180	B BOVERI	2B9546PD5BE081
181	B BOVERI	2B9546PD7BE082
182	B BOVERI	2B9546PD9BE083
183	B BOVERI	2B9546PD0BE084
184	B BOVERI	2B9546PD2BE085
185	B BOVERI	2B9546PD4BE086
186	B BOVERI	2B9546PD6BE087
187	B BOVERI	2B9546PD8BE088
188	B BOVERI	2B9546PDXBE089
189	B BOVERI	2B9546PD6BE090
190	B BOVERI	2B9546PD8BE091
191	B BOVERI	2B9546PDXBE092
192	B BOVERI	2B9546PD1BE093
193	B BOVERI	2B9546PD3BE094
194	B BOVERI	2B9546PD5BE095
195	B BOVERI	2B9546PD7BE096
196	B BOVERI	2B9546PD9BE097
197	B BOVERI	2B9546PD0BE098
198	B BOVERI	2B9546PD2BE099
199	B BOVERI	2B9546PD5BE100

BUS NUMBER: N/A
SERIAL NUMBER: 47-5075

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
MOTOR: CGE 1213PA
WIDTH: 8'6"(2 591 mm)
HORSEPOWER: 140(104.4 kW)
HEIGHT: 10'5"(3 175 mm)
AXLES: 2
WEIGHT: 18,510 lbs.(8 396 kg)
SEATING: 44

BUILT: 1947
WITHDRAWN: N/A
DELIVERY: 1969
DISPOSAL: 1972
REMARKS: FROM WINNIPEG, ex 1610

BUS NUMBER: N/A
SERIAL NUMBER: 47-5077-47-5079

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
MOTOR: CGE 1213PA
WIDTH: 8'6"(2 591 mm)
HORSEPOWER: 140(104.4 kW)
HEIGHT: 10'5"(3 175 mm)
AXLES: 2
WEIGHT: 18,510 lbs.(8 396 kg)
SEATING: 44

BUILT: 1947
WITHDRAWN: N/A
DELIVERY: 1969
DISPOSAL: 1972
REMARKS: FROM WINNIPEG, ex 1614, 1616, 1618

Units Obtained for Parts Only

BUS NUMBER: N/A
SERIAL NUMBER: 47-5082

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1947
DELIVERY: 1969
REMARKS: FROM WINNIPEG, ex 1624

WITHDRAWN: N/A
DISPOSAL: 1972

BUS NUMBER: N/A
SERIAL NUMBER: 47-5084

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1947
DELIVERY: 1969
REMARKS: FROM WINNIPEG, ex 1628

WITHDRAWN: N/A
DISPOSAL: 1972

BUS NUMBER: N/A
SERIAL NUMBER: 47-5086 & 47-5087

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1947
DELIVERY: 1969
REMARKS: FROM WINNIPEG, ex 1632, 1634

WITHDRAWN: N/A
DISPOSAL: 1972

BUS NUMBER: N/A
SERIAL NUMBER: 47-5090 & 47-5091

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1947
DELIVERY: 1969
WITHDRAWN: N/A
DISPOSAL: 1972
REMARKS: FROM WINNIPEG, ex 1640, 1642

BUS NUMBER: N/A
SERIAL NUMBER: 47-5505 to 47-550

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1947
DELIVERY: 1969
WITHDRAWN: N/A
DISPOSAL: 1972
REMARKS: FROM WINNIPEG, ex 1650 to 1658, EVEN NUMBERS

BUS NUMBER: N/A
SERIAL NUMBER: 47-5139

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1947
DELIVERY: 1974
WITHDRAWN: N/A
DISPOSAL: 1974
REMARKS: FROM CALGARY, ex 401

Units Obtained for Parts Only

BUS NUMBER: N/A
SERIAL NUMBER: 47-5141-47-5143

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1947
DELIVERY: 1974
WITHDRAWN: N/A
DISPOSAL: 1974
REMARKS: FROM CALGARY, ex 403-405

BUS NUMBER: N/A
SERIAL NUMBER: 47-5150 & 47-5151

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1947
DELIVERY: 1974
WITHDRAWN: N/A
DISPOSAL: 1974
REMARKS: FROM CALGARY, ex 412, 413

BUS NUMBER: N/A
SERIAL NUMBER: 47-5153 & 47-5154

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1947
DELIVERY: 1974
WITHDRAWN: N/A
DISPOSAL: 1974
REMARKS: FROM CALGARY, ex 415, 416

Units Obtained for Parts Only

BUS NUMBER: N/A
SERIAL NUMBER: 47-5166 & 47-5167

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)
MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1947
DELIVERY: 1974
WITHDRAWN: N/A
DISPOSAL: 1974
REMARKS: FROM CALGARY, ex 428, 429

BUS NUMBER: N/A
SERIAL NUMBER: 48-5216

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)
MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1948
DELIVERY: 1974
WITHDRAWN: N/A
DISPOSAL: 1974
REMARKS: FROM CALGARY, ex 435

BUS NUMBER: N/A
SERIAL NUMBER: 48-5234 & 48-5235

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)
MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1948
DELIVERY: 1974
WITHDRAWN: N/A
DISPOSAL: 1974
REMARKS: FROM CALGARY, ex 453 & 454

Units Obtained for Parts Only

BUS NUMBER: N/A
SERIAL NUMBER: 49-5688

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1949
DELIVERY: 1974
REMARKS: FROM CALGARY, ex 466

WITHDRAWN: N/A
DISPOSAL: 1974

BUS NUMBER: N/A
SERIAL NUMBER: 49-5691

MFR/MODEL: CCF-BRILL, T-44

LENGTH: 36'1"(10 998 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'5"(3 175 mm)
WEIGHT: 18,510 lbs.(8 396 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 44

BUILT: 1949
DELIVERY: 1974
REMARKS: FROM CALGARY, ex 469

WITHDRAWN: N/A
DISPOSAL: 1974

BUS NUMBER: N/A
SERIAL NUMBER: 50-8161

MFR/MODEL: CCF-BRILL, T-48A

LENGTH: 38'9.5"(11 824 mm)
WIDTH: 8'6"(2 591 mm)
HEIGHT: 10'6.25"(1 263 mm)
WEIGHT: 19,170 lbs.(8 696 kg)

MOTOR: CGE 1213PA
HORSEPOWER: 140(104.4 kW)
AXLES: 2
SEATING: 48

BUILT: 1950
DELIVERY: 1974
REMARKS: FROM CALGARY, ex 477

WITHDRAWN: N/A
DISPOSAL: 1974

Units Obtained for Parts Only

BUS NUMBER: N/A SERIAL NUMBER: 50-8163 & 50-8164

MFR/MODEL: CCF-BRILL, T-48A

LENGTH: 38'9.5"(11 824 mm) MOTOR: CGE 1213PA
WIDTH: 8'6"(2 591 mm) HORSEPOWER: 140(104.4 kW)
HEIGHT: 10'6.25"(1 263 mm) AXLES: 2
WEIGHT: 19,170 lbs.(8 696 kg) SEATING: 48

BUILT: 1950 WITHDRAWN: N/A
DELIVERY: 1974 DISPOSAL: 1974
REMARKS: FROM CALGARY, ex 479, 480

BUS NUMBER: N/A SERIAL NUMBER: 50-8320 & 50-8321

MFR/MODEL: CCF-BRILL, T-48A

LENGTH: 38'9.5"(11 824 mm) MOTOR: CGE 1213PA
WIDTH: 8'6"(2 591 mm) HORSEPOWER: 140(104.4 kW)
HEIGHT: 10'6.25"(1 263 mm) AXLES: 2
WEIGHT: 19,170 lbs.(8 696 kg) SEATING: 48

BUILT: 1950 WITHDRAWN: N/A
DELIVERY: 1974 DISPOSAL: 1974
REMARKS: FROM CALGARY, ex 481, 482

Appendix II

This Appendix consists of an example of correspondence between the author and one private company. The articles of correspondence illustrate the manner in which the author approached companies and individuals for research material and assistance. The Appendix also shows how helpful, kind and considerate most companies and individuals were in providing the author with research materials.

11752 Univ. Ave.,
Edmonton, Alberta
Canada T6G 1Z5
February 17, 1979

Mack Trucks Inc.
2100 Mack Blvd.,
Allentown, Pennsylvania, 18105

Dear Sir:

I am attempting to compile information, in order to write a thesis dealing with certain technical aspects of the Edmonton Transit System. One area of major importance, is the history of the trolley coach system. Your company supplied the Edmonton Street Railway (forerunner of the present system) with three, forty-passenger trolley coaches, in 1943. Those trolley coaches were some of the first to run in this city. Their fleet numbers were: 110, 111, 112. Their chassis numbers were: CR 1276, CR 1277, CR 1278. These coaches were used until 1965, when they were scrapped.

Aside from a few letters that the transit system has saved, very little reliable information remains here about the coaches. I would like to know any information that you might have about them. I am specifically interested in: blueprints, construction, electrical equipment, shop photos, exact delivery and construction dates, etc. I am willing to pay for a search fee, and for any reproduction. Please send the particulars to me, and I will reply right away. Reliable facts will make my work accurate. I remember frequently riding the Mack trolley coaches, but a thesis is not composed of recollections. I hope that you can help me, and I await your reply with interest.

Yours truly,

(signed)

George H. Buck

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MACK TRUCKS, INC.
One of The Signal Companies

April 24, 1979

Mr. George H. Buck
11752 University Ave.
Edmonten, Alberta
CANADA T6G 1Z5

Dear Mr. Buck:

Your letter of February 17, 1979, requesting information on trolley coaches in 1943 was referred to my office for reply.

Unfortunately, the chassis records for these coaches (CR 1276, 1277, 1278) are not available. I was able to find out the coaches were delivered February 14, 1943.

Attachments are as follows:

1. Standard Specification-Mack Model CR Trolley Coach
2. Sales Brochure
3. Chassis Drawing - 14RT454
4. Photos
   a. CR-1277-143V6204
   b. CR-1277- 143V6205

If I can be of further assistance, please don't hesitate to contact me.

Very truly yours,

MACK TRUCKS, INC.

R W Williams Jr.

R. W. Williams, Jr.
General Engineering

djs

Attach.

WORLD HEADQUARTERS: Engineering Division • P.O. Box 1761 • Allentown, Pa. 18105 • (215) 439-3011 • Telex: 084-7424

11752 Univ. Ave.,
Edmonton, Alberta
Canada T6G 1Z5
May 8, 1979

Mr. R. W. Williams Jr.
General Engineering
Mack Trucks Inc.,
P.O. Box 1761,
Allentown, Pa. 18105

Dear Mr. Williams:

I would like to thank you very much for the time and trouble you took in locating the superlative information on the three Edmonton CR trolley coaches. This information is exactly what I was hoping to find. Many questions that I had, were answered by the specifications and the brochure, and a previous belief was refuted by the photographs. It was maintained, by some, that the Mack trolley coaches arrived in Edmonton in a matt grey paint scheme. Your photographs show that the coaches arrived in Edmonton in the Edmonton Street Railway's colors. I have enclosed a photograph of Number 111 (CR 1277) in service in Edmonton, in July of 1943. It is on route 6, northbound on Scona Road, and passing an army detail. I assume, that since you said that the coaches were delivered in February 1943, they were actually constructed in late 1942.

In John Montville's book entitled Mack, he states that the model CR trolley coach was produced from 1934 to 1943. Was Edmonton's order the last CR coaches made? If it is too time consuming to find the answer, do not bother, as it is not an essential point.

Shortly after I wrote my original letter (February 17), I discovered that the Edmonton Transit System purchased, from your company in 1951, six diesel buses. Unfortunately, even less material exists about them than exists about the CR trolley coaches. I have been unable to find any record of their chassis numbers, or even the model number. An E.T.S. service roster lists them as fleet numbers 94 to 99, and as "36-passenger". According to John Montville's book, Mack never produced a 36 seater diesel bus. My guess, is that the model was either C-33, or C-37. The buses were apparently sold in 1964 to some unknown company, and all the records were sold with them. If it is not too much trouble or bother, could you find some information on these buses? These buses, and the CR trolley coaches, were the only Mack vehicles purchased by the transit system.

I thank you again for your work, time, and information, as well as for making my research and thesis a great deal easier.

Very truly yours,

(signed)

George H. Buck

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MACK TRUCKS, INC.
One of The Signal Companies

June 11, 1979

Mr. George H. Buck
11752 University Ave.
Edmonton, Alberta
CANADA T6G 1Z5

Dear Mr. Buck:

Thank you for your complimentary remarks in your correspondence dated May 8, 1979. I am always happy to assist whenever possible.

Regarding your question about the CR coaches, I was able to find out Edmonton's order was, in fact, the last order for CR coaches filled.

The six diesel buses you referred to are Model C-37. The chassis and building record indicates the buses were delivered for service to the City of Edmonton November 16, 1951.

Attachments are as follows:

1. Copy of chassis record
2. Catalog-Mack Bus Models C-33 & C-37
3. Photos - C37DT1296-1151C6208 thru C37DT1296-1151C6214

Thank you for your continued interest in Mack. If you have need of further assistance in your research, please contact me.

Good Luck!

Very truly yours,

R W Williams Jr

R. W. Williams, Jr.
General Engineering

djs/Attach.

WORLD HEADQUARTERS: Engineering Division • P.O. Box 1761 • Allentown, Pa. 18105 • (215) 439-3011 • Telex: 084-7424